UPDATED
CLASSIFICATION EXCEPTION AREA/ WELL RESTRICTION AREA

BRIDGEPORT RENTAL AND OIL SERVICES
Logan Township, Gloucester County, New Jersey

February 21, 2002

Prepared for:

BROS TECHNICAL COMMITTEE
Bridgeport, New Jersey

Prepared by:

ROUX ASSOCIATES, INC.
1222 Forest Parkway, Suite 190
West Deptford, New Jersey 08066

ROUX

BS49301J.689

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February 20, 2002

Mr. Rob Hoch
NJDEP
Responsible Party Remediation
Bureau of Federal Case Management
401 East State Street, P.O. Box 028
Trenton, NJ 08625-0028

RE: BROS Superfund Site, Updated Ground Water Classification Exception Area/Well Restriction Area

Dear Mr. Hoch:

The BROS Technical Committee is submitting an updated Ground Water Classification Exception Area/Well Restriction Area (CEA/WRA) for the BROS Superfund Site (2 copies enclosed). This update is made based on additional ground water data and the completion of ground water modeling, consistent with the New Jersey Department of Environmental Protection CEA/WRA guidance. Please call me if you have any questions.

Sincerely,

ENVIRONMENTAL LIABILITY MANAGEMENT, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

PPB:

Enclosure

c: Mr. Ronald Naman, P.G.

301274

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1.0 INTRODUCTION

On behalf of the BROS Technical Committee, Roux Associates, Inc. has prepared this updated Classification Exception Area/Well Restriction Area (CEA/WRA) report based upon the recent completion of a comprehensive remedial investigation. An initial CEA/WRA report was submitted to the New Jersey Department of Environmental Protection (NJDEP) in April 1999 (Roux, 1999) and approved on June 3, 1999. This investigation, the Phase 2 Remedial Investigation (RI), was performed between 1999 and 2001 in accordance with the United States Environmental Protection Agency (USEPA)-approved *BROS Phase 2 RI/FS Work Plan* (Roux, 1999a). The updated CEA/WRA report for the Bridgeport Rental and Oil Services (BROS) Superfund Site (BROS Site) has been prepared in accordance with the November 1998 NJDEP Final Guidance on Designation of Classification Exception Areas (NJDEP, 1998) and the New Jersey Ground Water Quality Standards (N.J.A.C.7:9-6.6). The purpose of establishing the CEA/WRA at the BROS site is to provide notice that the constituent standards for portions of two aquifers are not met and designated aquifers uses in localized areas are restricted unless special precautions or treatment is employed prior to water use. A CEA/WRA designation was established for the BROS Site because site-related chemical constituents have been detected in ground water at concentrations that exceed the NJDEP Ground Water Quality Criteria (GWQC) (N.J.A.C. 7:9-6.7). The WRA is updated for the area within the CEA where there is an exceedance of Primary Drinking Water Standards (N.J.A.C. 7:10) based on the confirmed distribution of BROS-related chemicals.

2.0 BACKGROUND

The BROS Superfund Site is located on Cedar Swamp Road in Logan Township, Gloucester County, New Jersey (Figure 1). At various times between 1960 and the 1980's, the current and previous owners and operators used the BROS property for several purposes, including waste-oil reprocessing, waste disposal, and waste storage. The USEPA placed the BROS Site on the National Priorities List on September 8, 1983 (See 48 Fed. Reg. 40, 658) and commenced an initial Remedial Investigation and Feasibility Study (RI/FS).

Prior to the initiation of waste-oil operations, the BROS property was an upland farm area that was subsequently used for a sand mining operation with the excavation extending below the water table. As a result of the sand mining, a 13-acre pond remained on the BROS property. The BROS property was developed into a waste-oil operation around 1960. During the period of used oil processing operations, between 1960 and the early 1980s, industrial operations occurred primarily in three areas: the used oil processing and storage tank area, buildings on the property, and the 13-acre pond, which became a waste-oil lagoon. The operations resulted in the deposition of petroleum wastes in soils and ground water. In 1972, following heavy rains associated with a hurricane, the lagoon overflowed into the adjacent Little Timber Creek Swamp. Interim lagoon stabilization actions were taken during the 1970s. The USEPA initiated a series of response actions in 1981 and began remedial actions following the signing of the 1984 Record of Decision (ROD).

Since the issuance of the 1984-ROD, the following remedial actions have been implemented:

- installation of potable water lines in the vicinity of those known residences whose supply wells could potentially contain site-related constituents;
- demolition and removal of the tanks, process vessels and underground piping;
- on-site incineration of oil, sludge, sediment and soil from the former lagoon;

- on-site treatment and discharge of 190 million gallons of ground water pumped from the lagoon during the incineration work;

- removal of sediment from a limited area in the adjacent wetlands, east of the former tank storage area and near US Route 130;

- on-site disposal of the incineration ash in the former lagoon area; and

- off-site disposal of debris, drums and other materials which could not be incinerated on-site.

Currently, the former lagoon area and the former waste oil processing and tank storage area are covered with clean soil (from off-site) and grass. The area of the former lagoon has been backfilled with off-site soils and incinerator ash from the on-site lagoon incineration activities. However, additional drum and soil hot spot removal work will be conducted by the USEPA in 2002. The BROS property is surrounded by a fence.

3.0 ENVIRONMENTAL SETTING AND QUALITY

The USEPA conducted preliminary remedial investigation activities to assess the quality of soils, ground water, and wetlands at the BROS Site. Data from these investigation activities were summarized in a report compiled by CH_2M Hill, the USEPA's contractor, in the March 1996 report titled *Summary of the Phase Two Remedial Investigation Work Performed to Date* (CH_2M Hill, 1996). Roux Associates, Inc., on behalf of the BROS Technical Committee, performed the Phase 2 RI field sampling between 1999 and 2001 in accordance with the USEPA-approved Work Plan (Roux , 1999a). The objectives of the Phase 2 RI included:

- the identification and characterization of sources at the BROS Site;
- the identification and delineation of site-related constituents that exceed relevant ground water quality standards;
- the identification of potential receptors to site-related ground water constituents of potential concern;
- the evaluation of hydrologic, geotechnical and stratigraphic aquifer properties; and
- the evaluation of site-specific geochemical parameters; and
- the development of a site-specific ground-water flow and fate and transport model.

The BROS Site lies within the Atlantic Coastal Plain physiographic province which is characterized by relatively flat topography, low gradient streams, and a series of alternating sand and clay dominated subsurface formations overlying bedrock. A thin surface strata of Recent alluvium covers the Upper Potomac-Raritan-Magothy Formation (Upper PRM). Ground water in the Recent alluvium and Upper PRM (Recent/Upper PRM aquifer) is under water table conditions near the surface. Recent fill material, alluvium, and peat layers associated with current and past wetland areas are mixed on the BROS property. The thickness of the Recent/Upper PRM ranges from 10 to 100 feet beneath the BROS Site. Site-related chemicals in

soil are primarily petroleum hydrocarbons, lead, polychlorinated biphenyls (PCBs) and volatile organic compounds (VOCs). They are limited to subsurface soils beneath the BROS property; primarily in the Recent alluvium and in fill material above the water table. Based on the results of the Phase 2 RI, the distribution of site-related constituents in soil beyond the BROS property is limited to the immediate vicinity of the BROS property, except in the adjacent swamp where chemical residuals are distributed in a decreasing gradient towards the north.

Ground water flow in the Recent/Upper PRM aquifer is driven by local topography and the downward vertical direction of flow in this recharge area. The horizontal ground water flow pattern in the Recent/Upper PRM aquifer at the BROS property is generally towards surface water bodies and is therefore radially away from the BROS property. The vertical direction of ground water flow in the Recent/Upper PRM aquifer is typically downward across the BROS Site. An aquifer test performed as part of the Phase 2 RI confirmed that the Recent/Upper PRM aquifer demonstrates the characteristics of an unconfined aquifer.

Historically (1980's), site-related constituents were detected at concentrations exceeding the NJDEP's GWQC north of the BROS property (CH_2M Hill, 1996). However, investigations after the removal of the process and storage equipment and the ground water treatment associated with the lagoon incineration have not detected exceedances of the GWQC in monitoring wells north of the BROS property. The distribution of site-related contamination, primarily VOCs, in the Recent/Upper PRM aquifer is limited to the BROS property and its immediate perimeter (Figure 2), consistent with the removal of sources and the natural attenuation of the residual chemicals in ground water.

Underlying the Recent/Upper PRM aquifer is an intermittent clay layer that grades to a silt dominant layer beneath a portion of the former waste oil lagoon. The clay layer is absent along the southeast side of the former lagoon. Beneath this upper confining layer is the Upper Middle PRM aquifer that ranges in thickness from 30 to 60 feet. An aquifer test in the Upper Middle PRM aquifer at the BROS property characterized the unit as a leaky confined aquifer with storage in the overlying aquitard. The vertical direction of ground water flow in the Upper Middle PRM aquifer is downward across the site. BROS-related chemical residuals in ground water consist primarily of VOCs that are distributed through the Upper Middle PRM aquifer

below the BROS property. Ground water flow in the Upper Middle PRM aquifer is predominantly to the southeast (away from the Delaware River) due to regional ground water withdrawal from the aquifer. However, north of a ground water divide, which runs northeast to the southwest on the north edge of the BROS property, ground water flows to the north towards the Delaware River. Downgradient to the southeast of the BROS property the VOCs are only detected at the base of the Upper Middle PRM aquifer, the 15 foot interval above the clay unit at the base of the Upper Middle PRM aquifer. Constituent concentrations decrease substantially with distance from the former lagoon (Figure 3).

The Lower Middle PRM aquifer underlies the Upper Middle PRM aquifer and is separated by a continuous clay layer which ranges in thickness from 8 to 20 feet beneath the BROS Site (CH_2M Hill, 1996). During the most recent sampling event in 1999, the concentrations of VOCs and semi-volatile organic compounds (SVOCs) detected in the Lower Middle PRM wells were below the NJDEP's GWQC.

4.0 GROUND WATER USE

NJDEP's Statewide Water Supply Plan (NJDEP, 1996) states that the area, including the site, is at the southern edge of Water Supply Critical Area #2 where there is an estimated deficit of water supply to meet the current and future water supply demands. Consequently, the plan recommends restriction on the withdrawal of ground water to reduce stress on the aquifer, allow for increased replenishment and recovery of the potentiometric head, and thereby reducing the potential for salt water intrusion.

An institutional control prohibiting the installation of water wells on the BROS property has been incorporated into the BROS property deed. Potable water line extensions were installed in the vicinity of the BROS property to service potentially-impacted residences. Potable water is supplied by the Pennsgrove Water Supply Company.

An extensive well search was conducted in the vicinity of the BROS property and over an area extending beyond the boundaries of the CEAs presented in this report. Most potentially impacted residences were connected to public water supply in the 1980s and 1990s. However, although a water line does run along the Swedesboro-Paulsboro Road, not all residences are currently connected to the water line, in particular, those residences whose houses are located an appreciable distance (over 100 feet) from the road. Ground water is used by some of the property owners to the south of Route I-295 for both potable and irrigation use. As part of the Phase 2 RI, ground water samples were collected from private supply wells identified between Swedesboro-Paulsboro Road and Route I-295, downgradient from the BROS property. No BROS-related constituents were identified in the samples collected from these wells. In addition to the limited use of ground water in the vicinity of the BROS Site, a substantial pumping and treatment program may be implemented at the nearby Chemical Leaman Superfund Site, to the west of the BROS Site. In summary, water uses and withdrawals from the aquifers on or near the BROS Site will be monitored for their potential influence on the CEA/WRA for the BROS Site.

5.0 CEA BOUNDARIES

Based on the extensive ground water sampling activities, and supported by ground water modeling performed as part of the Phase 2 RI, the ground water plume is stable and natural attenuation of BROS-related constituents is occurring downgradient of the BROS property (Appendix A). Ground water concentrations are predicted to continue declining over time, based upon the site-specific model and ground water quality data collected during the Phase 2 RI. Consistent with the NJDEP's guidance on CEAs, a separate CEA area was established for the portions of the two aquifers of concern at the BROS Site (Figures 2 and 4). The amended extent of the CEA boundaries for each aquifer is based on those monitoring wells where site-related constituents exceed the NJDEP's GWQC. In accordance with N.J.A.C. 7:26E6.2(a)17 (NJDEP, 1997), the maps with the proposed CEA boundaries are being submitted electronically on computer disk compatible with the NJDEP's Geographic Information System (Appendix B).

The CEA boundaries at the BROS Site are defined by the distribution of iron and manganese. Both iron and manganese concentrations in ground water are naturally high due to: (1) the extensive swamp habitats with high iron and manganese concentrations and reducing concentrations (Conner and Buford, 1998); (2) subsurface peat layers high in iron and manganese (Ponnamperuma, 1972); and (3) naturally low dissolved oxygen concentrations in ground water, especially down dip of outcrop areas of the PRM aquifer system (Lewis et al., 1991), that maintain conditions favorable to dissolved iron and manganese. At the BROS Site, the distribution of iron and manganese exceeding applicable constituent standards extends beyond the distribution of chemicals exceeding a ground water standard based on Primary Drinking Water Standards or Maximum Contaminant Levels (MCLs). Consequently, the boundary of the CEAs (Figures 2 and 4) were based on the distribution of BROS-related chemical constituents that exceed Secondary Drinking Water Standards (N.J.A.C. 7:10)(iron and manganese) and the regional background concentrations (Lewis et al., 1991).

The horizontal boundary of the CEA for the Recent/Upper PRM aquifer is limited to the BROS property and adjacent properties (Figure 2). The vertical extent is estimated to be 40 feet below ground surface (BGS) (Figure 5). In the Upper Middle PRM aquifer the vertical extent is estimated to be between 40 and 110 feet BGS below the BROS property and limited to the

bottom fifteen feet of the Upper Middle PRM aquifer in the area downgradient from the BROS property. The bottom of the Upper Middle PRM aquifer is typically from 95 to 110 feet BGS in the southern portion of the BROS property and dips to the south. South of Route 295, the bottom of the CEA is located between 135 and 150 feet BGS (Figure 5). In addition, south of Route I-295 (Figure 5) the water quality in the Upper PRM aquifer is not impacted by BROS-related chemicals and a continuous clay confining layer separates the Upper PRM aquifer from the Upper Middle PRM aquifer.

The CEA boundaries are predicted to be shrinking based on empirical data, an observed decrease in the distribution of site-related chemical constituents, and ground water flow and fate and transport modeling (Section 7 and Appendix A). Given that the CEA boundaries are currently based on iron and manganese exceeding NJDEP GWQC and background concentrations for inorganic constituents, the environmental fate and transport modeling was based on the organic chemicals that currently exceed NJDEP GWQC based on MCLs and have exhibited significant mobility and persistence in ground water at the BROS Site (Appendix A).

The properties that are included in the CEA for the Recent/Upper PRM aquifer are: Block 58.01/ Lot 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1; Block 59.02/Lots 14, 15; Block 59.04/Lots 3 through 6, 8 through 11.

The properties that are included in the CEA for the Upper Middle PRM aquifer which are located north of Route I-295 are: Block 58.01/Lots 1, 2, 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1; Block 59.02/Lots 13 through 16; Block 59.04/Lots 3 through 12. The properties that are included in the CEA for the Upper Middle PRM aquifer which are located south of Route I-295 are: Block 59/Lots 5, 5.01, 6, 11, 12, 13, 13.01, 14, 15.

6.0 CONSTITUENTS

The list of CEA constituents of concern consists of those compounds that were detected in the ground water at concentrations greater than the New Jersey GWQC during sampling rounds conducted in 1999 and 2001. Those CEA constituents are summarized below.

Recent/Upper PRM Aquifer (Figures 2 and 5)

VOCs
- Acetone
- Benzene
- 2-Butanone
- Chlorobenzene
- Chloroform
- cis-1,2-Dichloroethene
- 1,1-Dichloroethane
- 1,1-Dichloroethene
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- Methylene Chloride
- 1,1,1-Trichloroethane
- Tetrachloroethene
- Trichloroethene
- Vinyl Chloride

SVOCs
- 2-Methylnapthalene
- 4-Chloroaniline
- Bis(2-chloroethyl)ether
- Isophorone

Metals
- Aluminum
- Arsenic
- Beryllium
- Chromium
- Cobalt
- Iron
- Lead
- Manganese
- Nickel
- Selenium
- Sodium
- Thallium
- Zinc

Upper Middle PRM Aquifer (BROS property and surrounding properties, Figures 4 and 5)

VOCs
- Acetone
- Benzene
- 2-Butanone
- Carbon Disulfide
- Chlorobenzene
- Chloroform
- cis-1,2-Dichloroethene
- 1,1-Dichloroethane
- 1,1-Dichloroethene
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- Ethane
- Methylene Chloride
- 4-Methyl-2-pentanone
- Tetrachloroethene
- 1,1,2,2-Tetrachloroethane
- Toluene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Vinyl Chloride
- Xylenes (Total)

SVOCs
- 4-Chloroaniline
- Bis(2-chloroethyl)ether
- Isophorone
- Nitrobenzene

Metals
- Aluminum
- Arsenic
- Beryllium
- Chromium
- Cobalt
- Iron
- Lead
- Manganese
- Nickel
- Sodium
- Thallium
- Zinc

Upper Middle PRM Aquifer (South of Route I-295, Figures 3 and 5)

VOCs	*SVOCs*
Benzene	Bis(2-chloroethyl)ether
Chloroform	*Metals*
Trichloroethene	Aluminum
Vinyl Chloride	Arsenic
	Iron
	Manganese

In the Upper Middle PRM aquifer, the list of CEA constituents has been compiled separately for: (1) the area including the BROS property and surrounding properties; (2) the downgradient area along Route I-295; and (3) the area south of Route I-295. The rationale for providing this distinction is that many of the CEA constituents on or near the BROS-property naturally attenuate in close proximity to source areas. For example, 38 CEA constituents are detected on or near the BROS-property while the number decreases to 12 CEA constituents along Route I-295 and nine CEA constituents south of Route I-295. These findings are consistent with the fate and transport modeling and the empirical data that illustrate a decreasing distribution of constituents over the CEA areas from this time forward.

Currently, the only portion of the Upper Middle PRM aquifer CEA area where there is some ground water use in relatively close proximity to the CEA is south of Route I-295. In addition, there is a low potential for any ground water use in the CEA area north of Route I-295 because of existing and pending perpetual deed restrictions. Consequently, the list of CEA constituents from along Route I- 295 and south of I-295 are identified as the list of organic chemicals that are considered for more detailed assessment in the modeling and WRA assessment.

7.0 CEA LONGEVITY

The updated CEAs are established as part of the ground water remedy that will be approved by the NJDEP and the USEPA pursuant to the BROS Consent Decree. Extensive ground water investigation and modeling has been conducted during the Phase 2 RI. The extent of the updated CEAs are based primarily on the results of the most recent ground water sampling events (1999 through 2001) and the output of ground water modeling (Appendix A). These data and the results of the ground water modeling support a conclusion that the distribution of BROS-related chemicals has reached its maximum extent and is now stable and decreasing. A phased remedial program for ground water is the most likely remedial strategy that will be implemented following a Record of Decision. The extent of the CEAs may be revised periodically based on empirical data collected as part of the implementation of the future remedial action and as the distribution of BROS-related chemicals decreases with continuing natural attenuation.

As described previously, the former lagoon and ground water in close proximity to the lagoon was remediated in the late 1990s. As a result, ground water concentrations are decreasing within the updated CEA areas, and as has been apparent in the return of ground water quality standards in the Recent/Upper PRM aquifer north of the BROS property (Figure 3).

As noted in Section 5 (CEA Boundaries), the boundary of the CEA for the Recent/Upper PRM aquifer was established based on empirical data collected from the early 1980's to 1999. The distribution of CEA constituents has decreased and is predicted to decrease further as additional remedial actions are completed on the BROS property. Although indeterminate at this time, the area of the CEA will likely decrease to approximately the size of the BROS property within the next ten years.

The CEA longevity analysis for the Upper Middle PRM aquifer focused on the organic chemicals that exceed NJDEP GWQC. The concentration of BROS-related constituents exceeding Secondary Drinking Water Standards have attenuated to background concentrations at the boundary of the CEA. In addition, the assessment of the organic chemicals establishes the boundary of the WRA, which is a subset of the CEA area.

COPCs that were to be used to define the boundary of the WRA were initially evaluated based on the following criteria:

- Presence of the COPCs in ground water at monitoring locations that indicate a tendency for significant downgradient movement from the BROS property (i.e. at locations along and south of Route I-295); and

- Presence of the COPCs in ground water southeast of Route I-295 at concentrations exceeding NJDEP GWQC (N.J.A.C. Title 7, Chapter 9);

The results of this evaluation (detailed in Appendix A) yielded three compounds (benzene, bis(2-chloroethyl)ether [BCEE] and trichloroethene [TCE]) that have the highest concentrations in the source areas, are the most widespread and occur at the highest mean concentrations downgradient of source areas. Therefore, they are generally the most mobile and persistent at the BROS Site. Therefore, the limits of the WRA were defined based on the current or predicted extent of benzene, BCEE and TCE.

The modeling completed for benzene, BCEE and TCE predicts that concentrations of BROS-related constituents will decline to below the MCLs downgradient of the BROS property in approximately 20 years, without additional remedial action other than monitored natural attenuation. However, additional remedial actions on and downgradient of the BROS-property are being evaluated as part of the Feasibility Study. Implementation of additional remedial action would decrease the longevity of the CEA throughout the area of the CEA. Therefore, the proposed duration of the CEA is indeterminate at this time. The duration will likely be revised following a Record of Decision, as part of a New Jersey Pollutant Discharge Elimination System (NJPDES) permit equivalency application for the ground water remedial actions.

8.0 WELL RESTRICTION AREAS

The ground water in the vicinity of the BROS Site is classified as Class II-A, potable ground waters with conventional water treatment supply [N.J.A.C. 7:9-6.5(e)]. Therefore, an update of the Well Restriction Areas (WRAs) is requested from the NJDEP for the area where the New Jersey Primary Drinking Water Regulations (N.J.A.C. 7:10-5.1) are exceeded in each of the CEA aquifers (Exhibits B1 and B2 of the attached Fact Sheet). Note that the WRAs are a subset of the CEAs, as some inorganic constituents are present which exceed the NJDEP's GWQC (e.g., iron and manganese) but which are not included in the NJDEP's Primary Drinking Water Standards (N.J.A.C. 7:10-5.1). As noted in previous sections and detailed in Appendix A, the WRAs boundaries (Figures 2, 4 and 5) are the estimated maximum extent of the exceedances of the GWQC based on the empirical data and numerical ground water modeling.

The WRA within the Recent/Upper PRM aquifer is limited to the BROS property and close proximity (Figure 2). This WRA is predicted to decrease in size to the approximate boundaries of the BROS property where a permanent deed restriction prohibits ground water withdrawals, in part because of the deposition of the lagoon incinerator ash over a large portion of the BROS property. Vertically this WRA extends to approximately 40 feet BGS on the BROS property.

The WRA within the Upper Middle PRM aquifer extends from the top of aquifer, approximately 40 feet BGS, and extending to the base of the aquifer (approximately 100 feet BGS) on the BROS property (Figure 5). Beyond the BROS property, the WRA is limited to the bottom 15 feet of the Upper Middle PRM aquifer, based on the analysis of data from clustered wells, ground water flow and fate and transport modeling.

Private, irrigation and industrial withdrawal of ground water should be restricted within the WRA vertical and horizontal boundaries for each of the aquifers unless special precautions are taken or treatment is employed prior to water use. No restrictions are necessary for water withdrawal from the Upper PRM aquifer south of the BROS property because of the confining layer between the two aquifers. This would include all wells installed above the confining unit between the Upper PRM and Upper Middle PRM aquifers. Any low volume wells (e.g., residential wells) installed within the Upper Middle PRM aquifer should be installed in the upper

portion of the aquifer immediately below the confining unit between the Upper PRM and Upper Middle PRM aquifer. Ground water monitoring with analysis for VOCs would be recommended for any wells installed within the upper portion of the Upper Middle PRM aquifer above the WRA. Wells that withdraw large volumes of water are not recommended within the Upper Middle PRM aquifer above the WRA, unless a contingency for treatment is employed. Wells that may be installed into the Lower Middle PRM aquifer underneath the WRA should be constructed with double casing set into the confining unit between the Upper Middle PRM and Lower Middle PRM aquifers to prevent the potential movement of constituents of concern into the underlying aquifer. In addition, it is recommended that the NJDEP evaluate any applications requested for Water Allocation Permits in the vicinity of the BROS Site for the potential consequences of their withdrawals on the ground water within the CEAs, especially considering the expected ground water withdrawal effects of the Chemical Leaman Superfund Site pumping and treatment of ground water would have if implemented.

Similar to the CEA, the WRA will be reduced with time, depending on the remedial actions selected at the conclusion of the Phase 2 RI/FS (Section 7.0).

The properties that are included in the WRA for the Recent/Upper PRM aquifer are: Block 59.04/Lots 3, 4, 8, 9, 10 and 11. The properties that are included in the WRA for the Upper Middle PRM aquifer are: Block 58.01/Lots 2, 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1; Block 59/Lots 7, 11, 12, 13, 13.01; Block 59.02/Lots 13, 14, 15; Block 59.04/Lots 3 through 12.

Upon the NJDEP's approval of the updated CEA all effected property owners will be notified of the CEA and associated WRA.

REFERENCES

CH_2M Hill, 1996. *Summary of the Phase Two Remedial Investigation (RI) Work Performed to Date*, Prepared for USEPA.

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Roux Associates, Inc., 1999a. *BROS Phase 2 RI/FS Work Plan*, June 25, 1999.

CLASSIFICATION EXCEPTION AREA/WELL RESTRICTION AREA FACT SHEET

Site Name: Bridgeport Rental and Oil Services **DATE: February 21, 2002**
Location: Logan Township, Gloucester County
Block/Lots: Recent/Upper PRM aquifer Classification Exception Area (CEA) - Block 58.01/Lot 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1, Block 59.02/Lots 14, 15; Block 59.04/Lots 3 through 6, 8 through 11: Well Restriction Area (WRA) - Block 59.04/Lots 3, 4, 8, 9, 10 and 11.

Upper Middle PRM aquifer CEA - Block 58.01/Lots 1, 2, 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1; Block 59/Lots 5, 5.01, 6, 11, 12, 13, 13.01, 14, 15; Block 59.02/Lots 13 through 16; Block 59.04/Lots 3 through 12: WRA - Block 58.01/Lots 2, 3; Block 58.02/Lots 1, 2; Block 58.03/Lot 1; Block 59/Lots 7, 11, 12, 13, 13.01; Block 59.02/Lots 13, 14, 15; Block 59.04/Lots 3 through 12.

See Exhibit A (Site Location Map)

Site Contact Person: BROS Technical Committee,
c/o Peter Brussock, Ph.D.
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4920 York Road, Suite 2CC2
P.O. Box 306
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Phone Number: (215) 794-6920, Ext. 11

Case Number: NJD053292652

NJDEP Lead Program: Division of Federal Case Management, Rob Hoch (609) 292-1493

USEPA Approval Document: *Phase 2 Remedial Investigation/Feasibility Study Work Plan* approved January 11, 1999

Description of CEA
The aquifers beneath the BROS site which have concentrations of constituents of potential concern that exceed either the New Jersey Department of Environmental Protection (NJDEP) Ground Water Quality Standards (N.J.A.C. 7:9-6) or the USEPA Primary Maximum Contaminant Levels (40 CFR 141) include:

1) the Recent alluvium, which is intermixed with the Upper Potomac-Raritan-Magothy (PRM) formation to form the Recent/Upper PRM aquifer, which varies in thickness between 10 and 40 feet below the BROS property; and

2) the Upper Middle PRM aquifer, which varies in thickness from 60 feet (beneath the BROS property) to 30 feet downgradient of the BROS property.

Pursuant to N.J.A.C. 7:9-6.5, the aquifers in this area are presently designated as Class II-A. The primary designated use for Class II-A ground water is potable water; secondary uses include

agricultural and industrial water. Any proposed ground water use within the CEA will require Department review for feasibility of well installation and modifications that would be protective of any impacts from these contaminants for the duration of the CEA.

This CEA/WRA applies only to the chemicals detected in the aquifer as listed in the tables below. The ground water quality criteria/primary drinking water standards for these chemicals are listed in parts per billion (ppb). All constituent standards (N.J.A.C. 7:9-6) apply at the designated boundary.

For the Recent/Upper PRM aquifer:

Contaminant	NJDEP Ground Water Quality Criteria/Federal Primary MCL (ppb)
Acetone	700/-
Benzene	1/5
2-Butanone	300/-
Chlorobenzene	50*/100
Chloroform	6/80
cis-1,2-Dichloroethene	70*/70
1,1-Dichloroethane	50*/-
1,1-Dichloroethene	2*/-
1,2-Dichloroethane	2/5
1,2-Dichloropropane	1/5
Methylene Chloride	3*/5
1,1,1-Trichloroethane	30*/200
Tetrachloroethene	1/5
Trichloroethene	1/5
Vinyl Chloride	5/2
2-Methylnapthalene	100*/-
4-Chloroaniline	30*/-
Bis(2-chloroethyl)ether	10/-
Isophorone	100/-
Aluminum	200/-
Arsenic	8/5
Beryllium	20/4
Chromium	100/100
Cobalt	100*/-
Iron	300/-
Lead	10/15
Manganese	50/-
Nickel	100/-
Selenium	50/50
Sodium	50,000/-
Thallium	10/2
Zinc	5,000/-

* Interim NJDEP GWQC
- No Federal Primary MCL

For the Upper Middle PRM aquifer (BROS property and surrounding properties):

Contaminant	NJDEP Ground Water Quality Criteria/Federal Primary MCL (ppb)
Acetone	700/-
Benzene	1/5
2-Butanone	300/-
Carbon Disulfide	800*/-
Chlorobenzene	50*/100
Chloroform	6/80
cis-1,2-Dichloroethene	70*/70
1,1- Dichloroethane	50*/-
1,1- Dichloroethene	2*/-
1,2-Dichloroethane	2/5
1,2-Dichloropropane	1/5
Ethane	100*/-
Methylene Chloride	2/5
4-Methyl-2-pentanone	400/-
Tetrachloroethene	1/5
1,1,2,2-Tetrachloroethane	1*/-
Toluene	1,000/1,000
1,1,1-Trichloroethane	30/200
1,1,2-Trichloroethane	3/5
Trichloroethene	1/5
Vinyl Chloride	5/2
Xylenes	40/10,000
4-Chloroaniline	30*/
Bis(2-chloroethyl)ether	10/-
Isophorone	100/-
Nitrobenzene	10/-
Aluminum	200/-
Arsenic	8/5
Beryllium	20/4
Chromium	100/100
Cobalt	100*/-
Iron	300/-
Lead	10/15
Manganese	50/-
Nickel	100/-
Sodium	50,000/-
Thallium	10/2
Zinc	5,000/-

* Interim NJDEP GWQC
- No Federal Primary MCL

For the Upper Middle PRM aquifer (South of Route I-295):

Contaminant	NJDEP Ground Water Quality Criteria/Federal Primary MCL (ppb)
Benzene	1/5
Chloroform	6/80
Trichloroethene	1/5
Vinyl Chloride	5/2
Bis(2-chloroethyl)ether	10/-
Aluminum	200/-
Arsenic	8/5
Iron	300/-
Manganese	50/-

* Interim NJDEP GWQC
- No Federal Primary MCL

Horizontal Boundaries See Exhibits B1 and B2 (Proposed CEA and WRA Boundary Maps).

Vertical Boundaries

Recent/Upper PRM Aquifer — Base of Recent/Upper PRM aquifer at a depth of approximately 40 feet below ground surface (BGS) below and immediately adjacent to the BROS property.

Upper Middle PRM Aquifer — Base of Upper Middle PRM aquifer at a depth between 40 and 110 feet BGS below the BROS property and only the bottom fifteen feet of the Upper Middle PRM aquifer downgradient from the BROS property. This portion of the Upper Middle PRM aquifer is typically from 95 to 110 feet BGS in the southern portion of the BROS property and dips to the south. South of Route I-295, the CEA is located between 135 and 150 feet BGS.

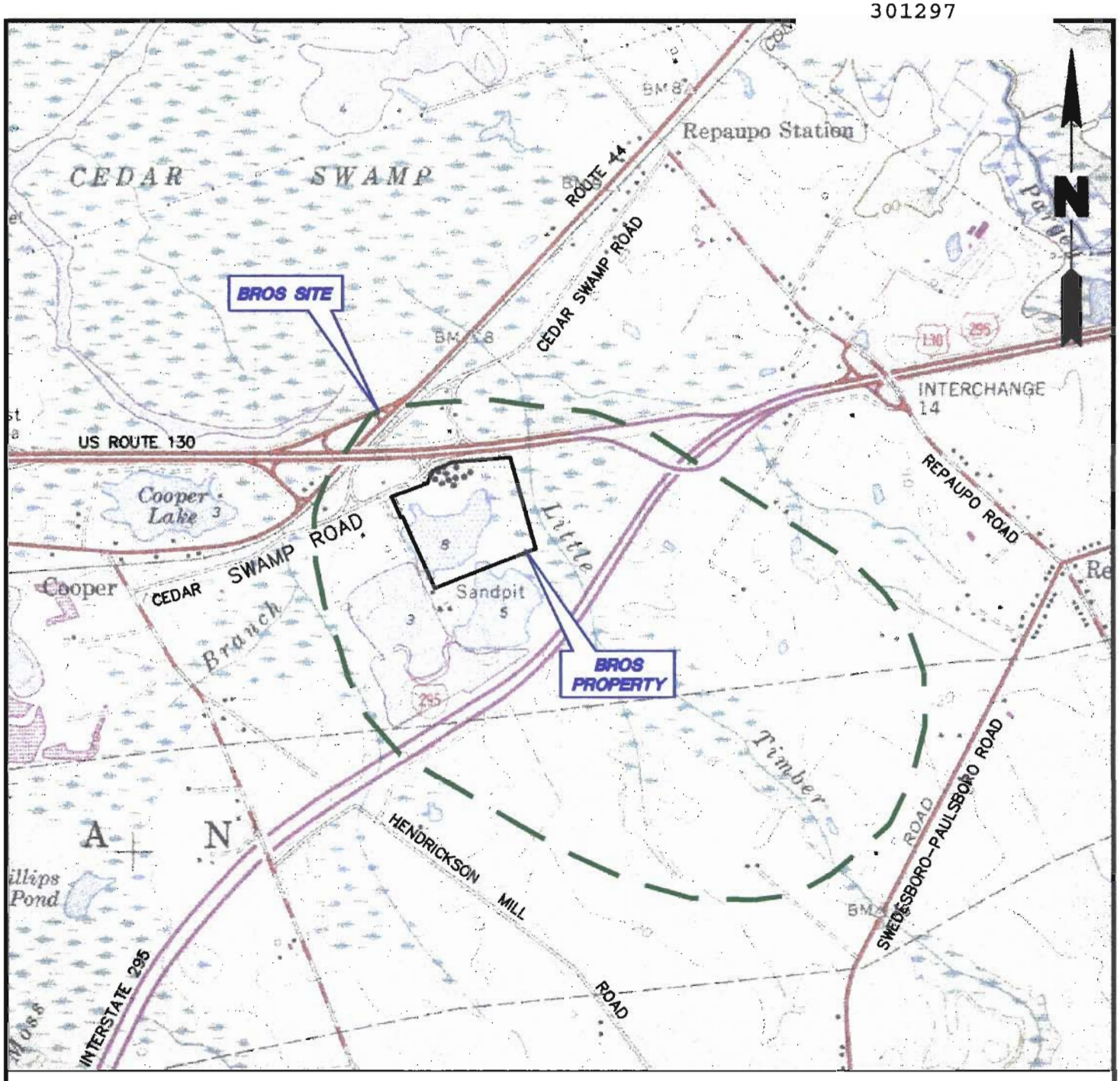
The proposed duration of the CEA is indeterminate at this time. However, the ground water concentrations are decreasing within the updated CEA areas. Consequently, the CEA in the Recent/Upper Middle PRM aquifer will likely decrease to approximately the size of the BROS property within the next ten years, and BROS related constituents will decline to below the health based drinking water standards downgradient of the BROS property in the Upper Middle PRM aquifer in approximately 20 years, with no additional remedial action. Nonetheless, ground water remediation will be conducted based on a future ground water cleanup plan selected by the USEPA in a Record of Decision (ROD) and the duration of the CEA will continue through the Phase 2 RI/FS and the period of remediation.

Note: Since ground water quality data indicates exceedances of contaminants above the Primary Drinking Water Standards, and the designated uses of Class II-A aquifers include potable use, a WRA is also memorialized. The extent of WRA boundaries is presented on Exhibits B1 and B2.

Private, irrigation and industrial withdrawal of ground water is restricted from within the WRA vertical and horizontal boundaries for each of the aquifers unless special precautions are taken or treatment is employed prior to water use. No restrictions are necessary for water withdrawal

from the Upper PRM aquifer south of the BROS property because the confining layer between the two aquifers. This would include all wells installed above the confining unit between the Upper PRM and Upper Middle PRM aquifers. Any low volume wells (e.g., residential wells) installed within the Upper Middle PRM aquifer should be installed in the upper portion of the aquifer immediately below the confining unit between the Upper PRM and Upper Middle PRM aquifers. Ground water monitoring with analysis for VOCs is recommended for any wells installed within the upper portion of the Upper Middle PRM aquifer above the WRA. Wells that withdraw large volumes of water are not recommended within the Upper Middle PRM aquifer above the WRA, unless a contingency for treatment is employed. Wells that may be installed into the Lower Middle PRM aquifer underneath the WRA should be constructed with double casing set into the confining unit between the Upper Middle PRM and Lower Middle PRM aquifers to prevent the potential movement of constituents of concern into the underlying aquifer. In addition, it is recommended that the NJDEP evaluate any applications requested for Water Allocation Permits in the vicinity of the BROS Site for the potential consequences of their withdrawals on the ground water within the CEAs, especially considering the expected ground water withdrawal effects of the Chemical Leaman Superfund Site pumping and treatment of ground water would have if implemented.

301297



QUADRANGLE LOCATION

LEGEND

APPROXIMATE BROS SITE BOUNDARY BASED ON GROUND WATER DATA

APPROXIMATE BROS PROPERTY BOUNDARY

SOURCE

1.) U.S.G.S. BRIDGEPORT, N.J., QUADRANGLE 1967 7.5 MINUTE SERIES (TOPOGRAPHIC) PHOTOREVISED 1986 CONTOUR INTERVAL 10 FEET

Title:

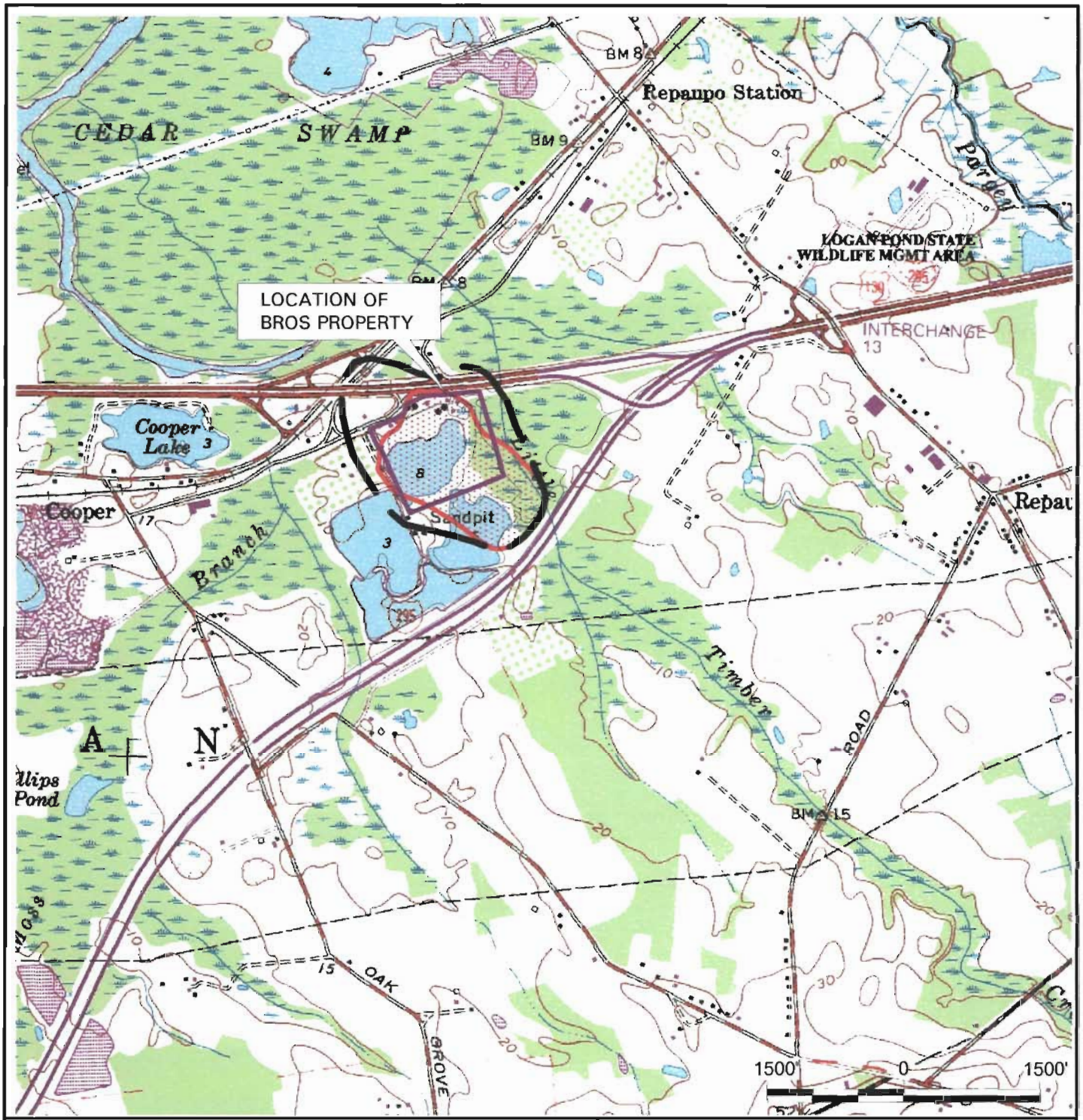
BROS SITE LOCATION MAP

LOGAN TOWNSHIP, NEW JERSEY
BRIDGEPORT RENTAL & OIL SERVICES SITE

Prepared For:

BROS TECHNICAL COMMITTEE

ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: WG	Date: 02/23/02	EXHIBIT A
	Prepared by: JSG	Scale: AS SHOWN	
	Project Mgr: NR	Office: NJ	
	File No: 49301372	Project: 49301J	



LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

NEW JERSEY

QUADRANGLE LOCATION

N

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND UPPER PRM AQUIFER

Prepared For:

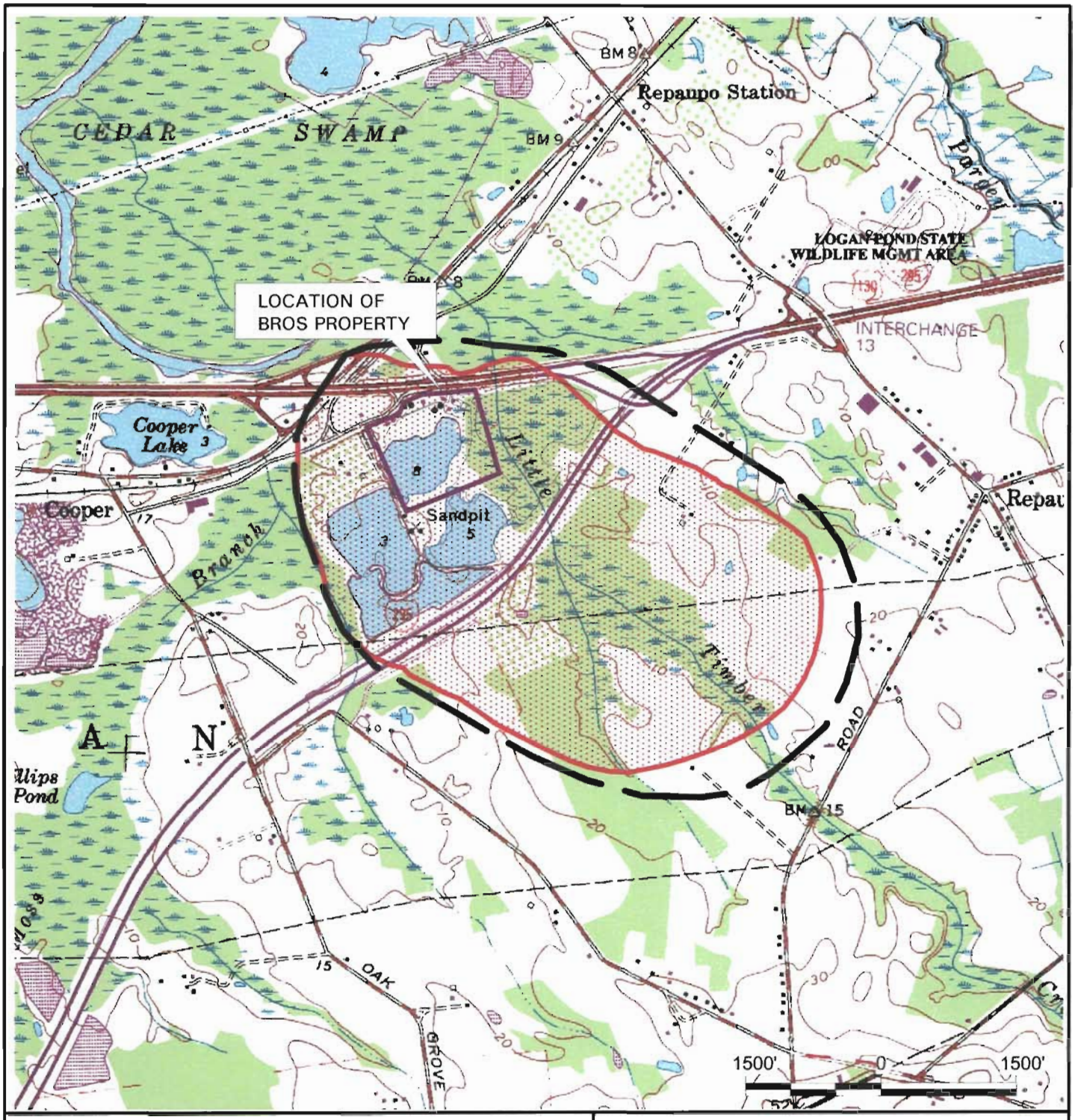
BROS TECHNICAL COMMITTEE

BROS SUPERFUND SITE, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/10/02	EXHIBIT
Prepared by: S.S.	Scale: AS SHOWN	B1
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110701.WOR	Project: 49301.1	

301298



LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA AT THE BASE OF THE UPPER MIDDLE PRM AQUIFER (LOWER 15 FEET)

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA UPPER MIDDLE PRM AQUIFER

NEW JERSEY

QUADRANGLE LOCATION

N

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR THE UPPER MIDDLE PRM AQUIFER

Prepared For:

BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

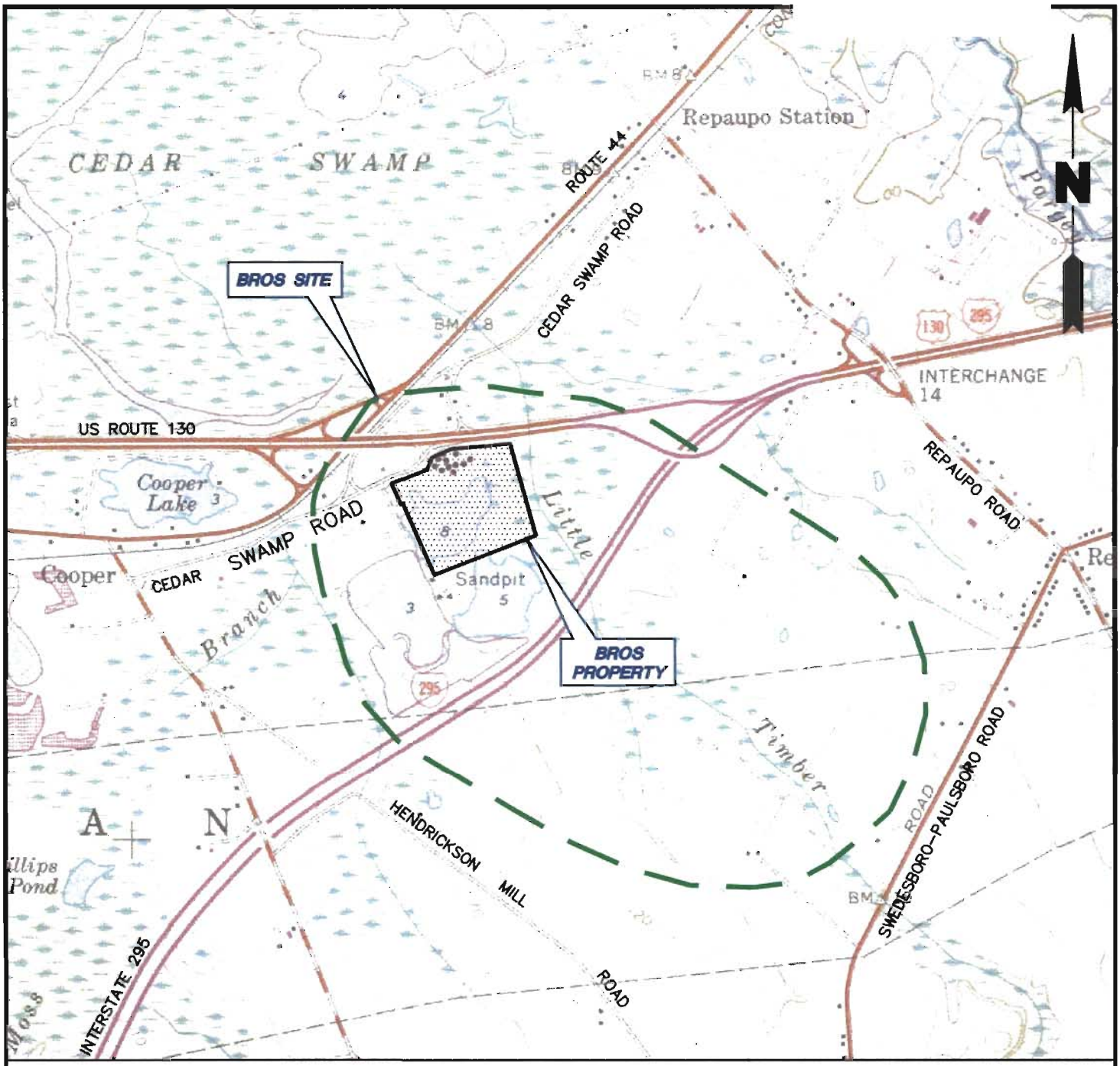
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 2/12/02	EXHIBIT
Prepared by: S.S.	Scale: AS SHOWN	B2
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110702.WOR	Project: 49301J	

301299

FIGURES

301301



QUADRANGLE LOCATION

2,000' 0' 2,000'

LEGEND

APPROXIMATE BROS SITE BOUNDARY BASED ON GROUND WATER DATA

APPROXIMATE BROS PROPERTY BOUNDARY

SOURCE

1.) U.S.G.S. BRIDGEPORT, N.J., QUADRANGLE 1967 7.5 MINUTE SERIES (TOPOGRAPHIC) PHOTOREVISED 1986 CONTOUR INTERVAL 10 FEET

Title:

BROS SITE LOCATION MAP

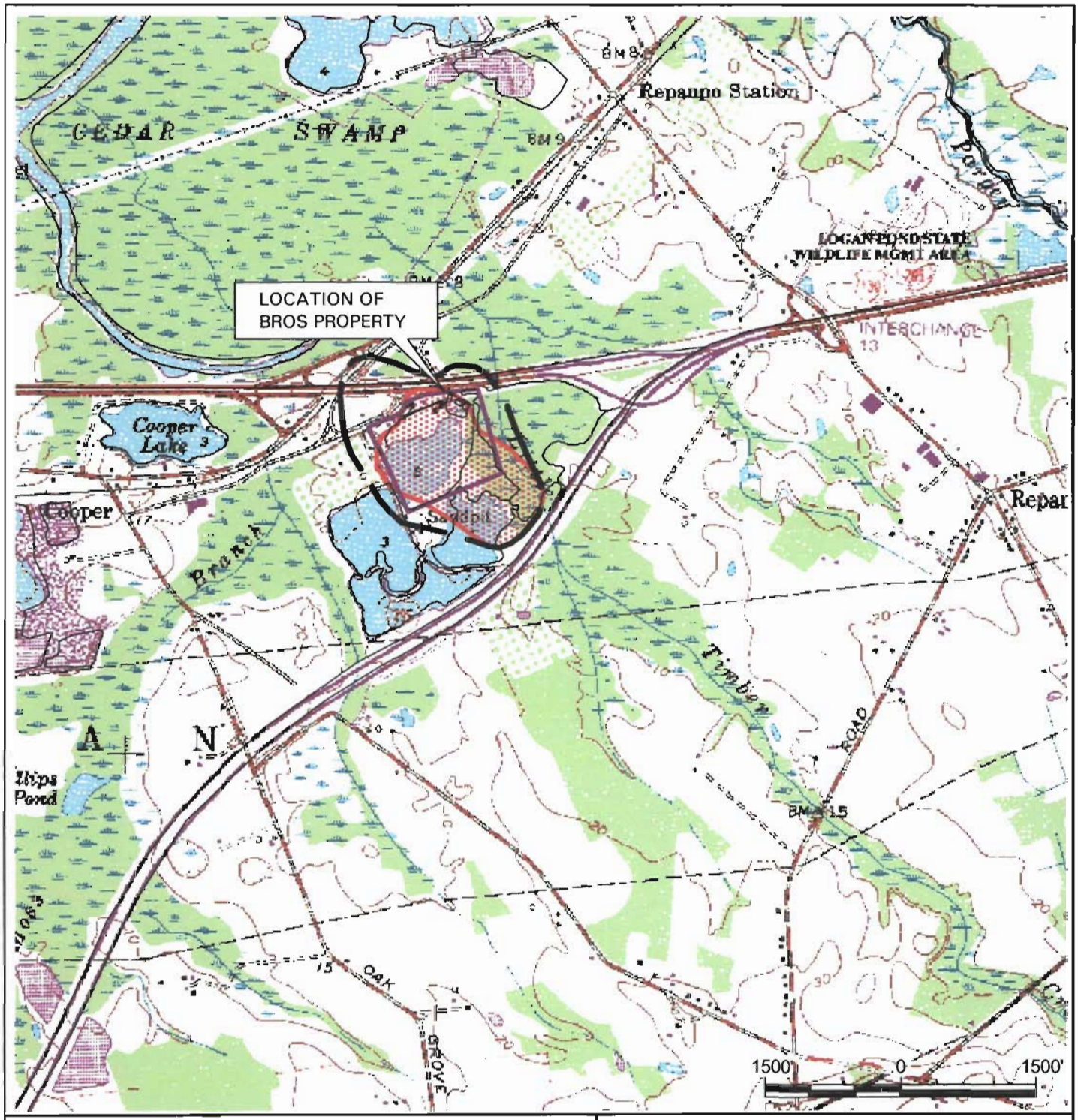
BRIDGEPORT RENTAL & OIL SERVICES SITE
LOGAN TOWNSHIP, NEW JERSEY

Prepared For:

BROS TECHNICAL COMMITTEE

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.G.	Date: 12/21/01	FIGURE
Prepared by: JSG	Scale: AS SHOWN	1
Project Mgr: N.R.	Office: NJ	
File No: 49301372	Project: 49301J	



LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

QUADRANGLE LOCATION

N

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND UPPER PRM AQUIFER

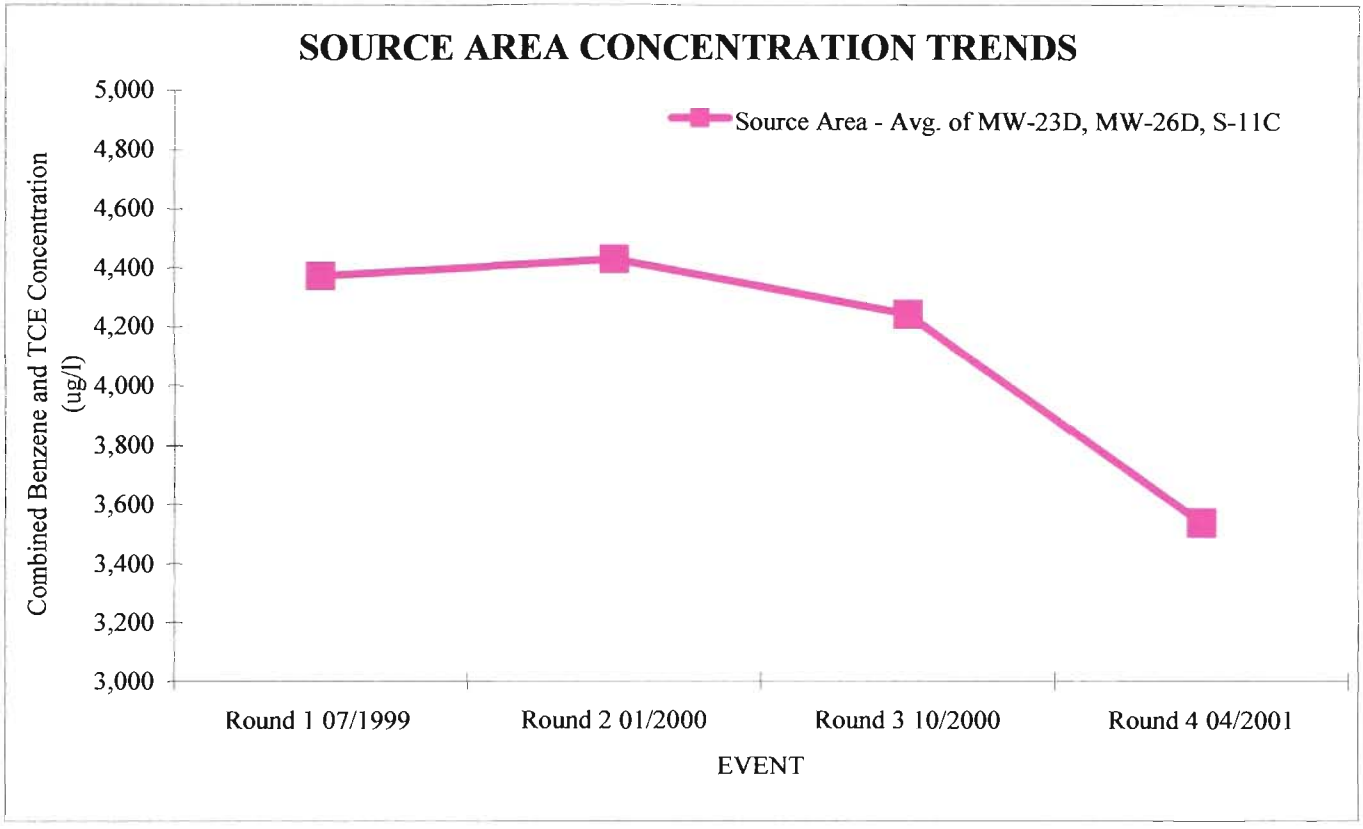
Prepared For:

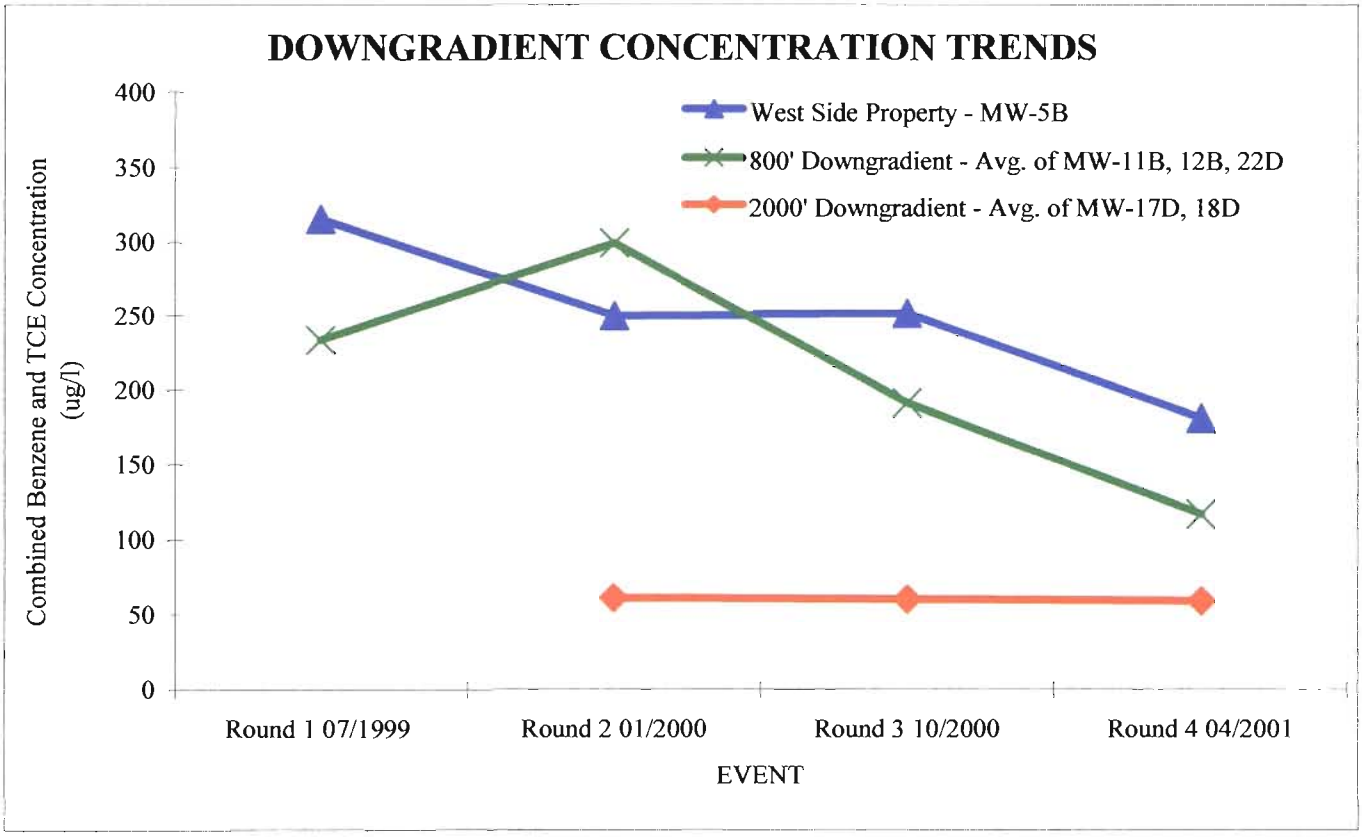
BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

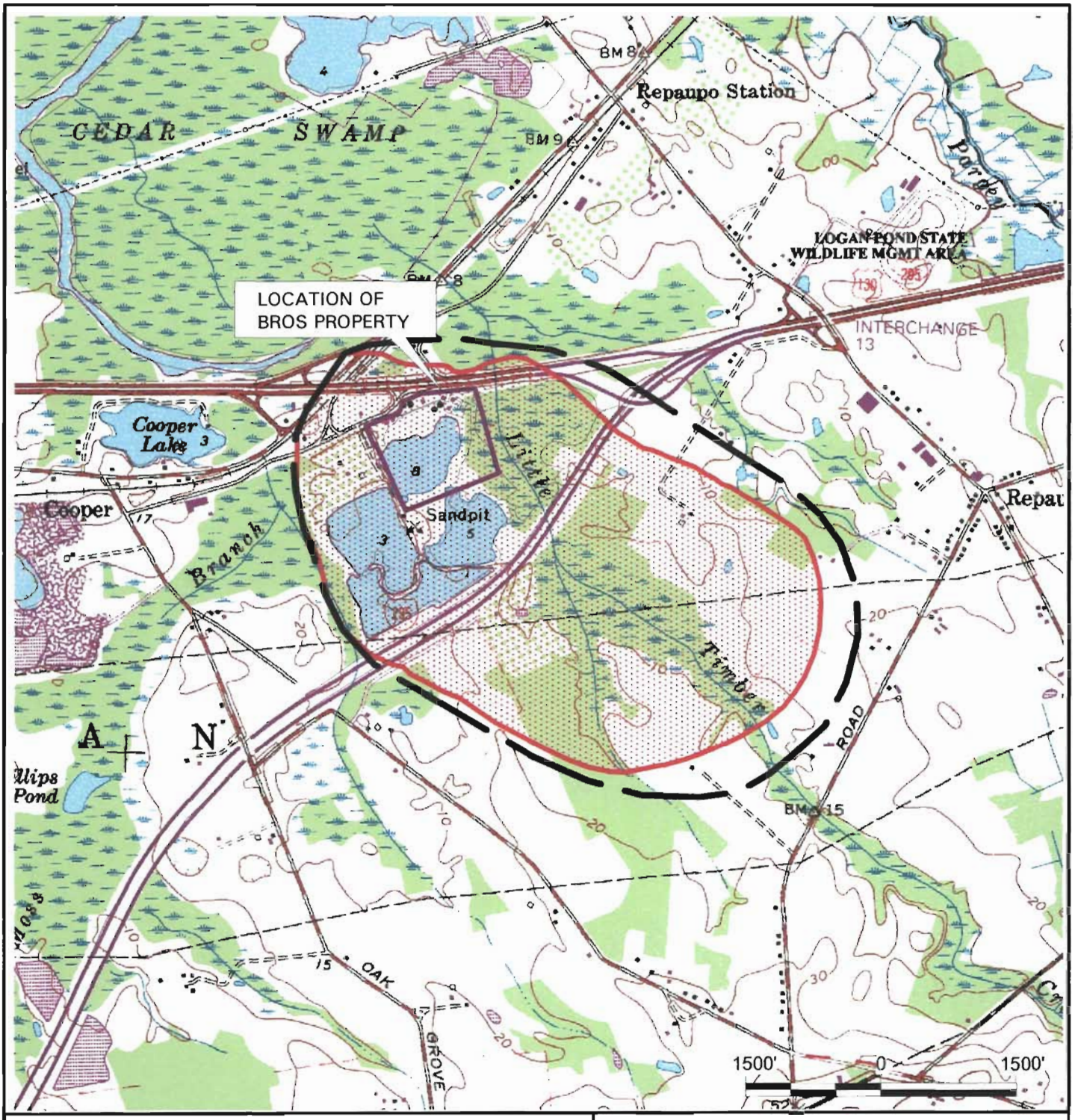
ROUX ASSOCIATES INC. Environmental Consulting & Management	Compiled by: S.S.	Date: 1/10/02	FIGURE 2
	Prepared by: S.S.	Scale: AS SHOWN	
	Project Mgr: N.R.	Office: N.Y.	
	File No: BP0110701.WOR	Project: 49301J	

301302

Figure 3. Average Concentrations of Benzene and Trichloroethene in Monitoring Wells at Varying Distances from the BROS Property from July, 1999 to April, 2001.







LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA AT THE BASE OF THE UPPER MIDDLE PRM AQUIFER (LOWER 15 FEET)

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA UPPER MIDDLE PRM AQUIFER

NEW JERSEY

QUADRANGLE LOCATION

N

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR THE UPPER MIDDLE PRM AQUIFER

Prepared For:

BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

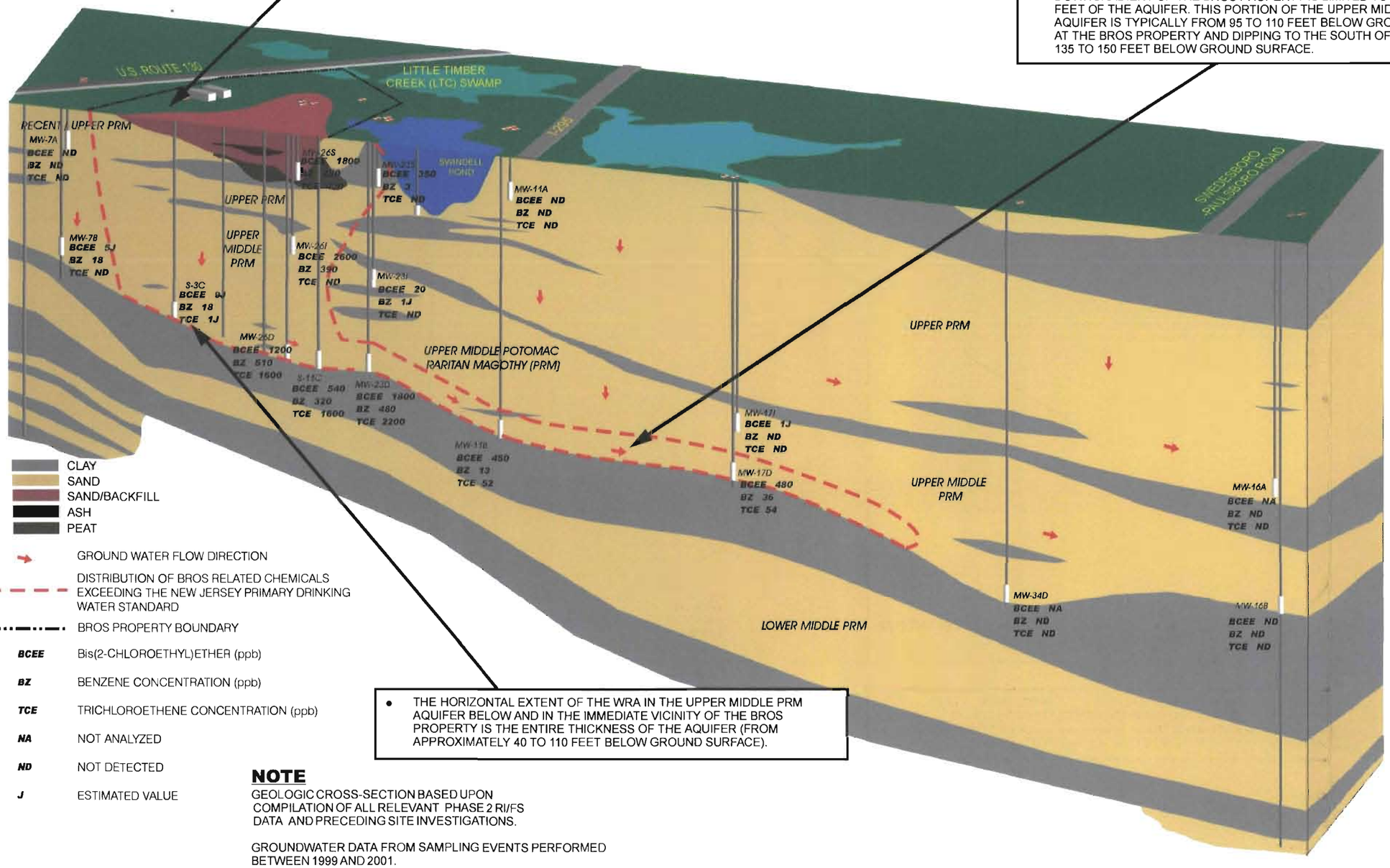
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 2/12/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	4
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110702.WOR	Project: 49301J	

301304

- THE HORIZONTAL EXTENT OF THE WRA IN THE RECENT/UPPER PRM AQUIFER IS LIMITED TO THE BROS PROPERTY AND IMMEDIATE VICINITY.
- THE VERTICAL EXTENT OF THE WRA IN THE RECENT/UPPER PRM AQUIFER IS APPROXIMATELY 40 FEET BELOW THE GROUND SURFACE. THE MAJORITY OF THE BROS-RELATED CHEMICALS IS PRESENT IN THE RECENT ALLUVIUM BELOW THE BROS PROPERTY WITH MINOR AMOUNTS OF BROS-RELATED CHEMICALS PRESENT IN THE UPPER PRM PORTION OF THE AQUIFER PRESENT AT DEPTHS GREATER THAN 20 FEET BELOW THE GROUND SURFACE.

- THE HORIZONTAL EXTENT OF THE WRA IN THE UPPER MIDDLE PRM AQUIFER DOWNGRADIENT FROM THE BROS PROPERTY EXTENDS TO THE SOUTH APPROXIMATELY MIDWAY BETWEEN ROUTE I-295 AND SWEDESBORO-PAULSBORO ROAD.
- THE VERTICAL EXTENT OF THE WRA IN THE UPPER MIDDLE PRM AQUIFER DOWNGRADIENT OF THE BROS PROPERTY IS LIMITED TO THE BOTTOM 15 FEET OF THE AQUIFER. THIS PORTION OF THE UPPER MIDDLE PRM AQUIFER IS TYPICALLY FROM 95 TO 110 FEET BELOW GROUND SURFACE AT THE BROS PROPERTY AND DIPPING TO THE SOUTH OF ROUTE I-295 TO 135 TO 150 FEET BELOW GROUND SURFACE.



CLAY
SAND
SAND/BACKFILL
ASH
PEAT

GROUND WATER FLOW DIRECTION

DISTRIBUTION OF BROS RELATED CHEMICALS EXCEEDING THE NEW JERSEY PRIMARY DRINKING WATER STANDARD

BROS PROPERTY BOUNDARY

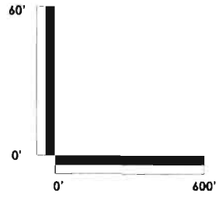
BCEE	Bis(2-CHLOROETHYL)ETHER (ppb)
BZ	BENZENE CONCENTRATION (ppb)
TCE	TRICHLOROETHENE CONCENTRATION (ppb)
NA	NOT ANALYZED
ND	NOT DETECTED
J	ESTIMATED VALUE

- THE HORIZONTAL EXTENT OF THE WRA IN THE UPPER MIDDLE PRM AQUIFER BELOW AND IN THE IMMEDIATE VICINITY OF THE BROS PROPERTY IS THE ENTIRE THICKNESS OF THE AQUIFER (FROM APPROXIMATELY 40 TO 110 FEET BELOW GROUND SURFACE).

NOTE

GEOLOGIC CROSS-SECTION BASED UPON COMPILATION OF ALL RELEVANT PHASE 2 RI/FS DATA AND PRECEDING SITE INVESTIGATIONS.

GROUNDWATER DATA FROM SAMPLING EVENTS PERFORMED BETWEEN 1999 AND 2001.



APPROXIMATE SCALE

TITLE: **CONCEPTUALIZED GEOLOGIC CROSS-SECTION ILLUSTRATING THE CROSS-SECTIONAL AREA OF THE WELL RESTRICTION AREAS FOR THE UPPER PRM AND UPPER MIDDLE PRM AQUIFERS**

PREPARED FOR: **BROS TECHNICAL COMMITTEE**

PREPARED BY: ROUX ASSOCIATES, INC. Environmental Consulting & Management

FIGURE **5**

APPENDICES

APPENDIX A

APPENDIX A

SUMMARY OF GROUND WATER MODELING

TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS

(Continued)

FIGURES

PLATES

1.0 INTRODUCTION

To complete a Classification Exception Area (CEA) / Well Restriction Area (WRA) proposal for the Bridgeport Rental and Oil Services (BROS) Superfund Site in Bridgeport, New Jersey (Site), two issues must be addressed:

1. the amount of time necessary for the compounds of potential concern (COPCs) to reach New Jersey Department of Environmental Protection (NJDEP) Groundwater Quality Criteria (GWQC) (NJAC Title 7, Chapter 9); and

2. the distance that the chemical constituents will be transported with ground water flow above GWQS (NJDEP, 1998).

As discussed throughout the text of this report, the CEA boundaries are set where the Secondary Drinking Water Standards are exceeded up to the point where ground water concentrations have naturally attenuated to regional background concentrations. However, to be certain that the organic chemical constituents will not extend past the updated CEA boundaries and to assist in establishing the WRAs boundary, numerical modeling consistent with NJDEP guidance was conducted to project the boundaries of the WRAs and approximate the time necessary to achieve the GWQS. In addition, there are multiple chemicals detected and these chemicals may vary in distribution and concentration across the BROS Site. To account for these variabilities, the chemical constituents with the greatest mobility and persistence and the highest concentrations in the source area beneath the BROS Site, were used in the model.

2.0 HYDROGEOLOGIC SETTING

Five hydrogeologic units of interest have been identified underlying the Site based on the distribution of BROS-related chemicals. These units include:

1. fill material, Recent alluvium and Upper Potomac Raritan Magothy (Recent/Upper PRM) aquifer;
2. the confining bed between the Recent/Upper PRM aquifer and the Upper Middle PRM aquifer (basal silty clay unit);
3. the Upper Middle PRM aquifer;
4. the confining layer between the Upper Middle PRM and the Lower Middle PRM aquifers; and
5. the Lower Middle PRM aquifer.

A review of the results of the Phase 2 Remedial Investigation (RI) performed for the BROS Site has indicated that only the Recent/Upper PRM and Upper Middle PRM aquifers are impacted as a result of historical activities at the BROS Site. Therefore, WRAs are proposed for only these two aquifers. The confining layer between the Upper Middle PRM and the Lower Middle PRM aquifers is considered the lower boundary for the flow system as far as the model grid extent was concerned.

2.1 Recent/Upper PRM Aquifer

The BROS Site lies in the recharge area of the Recent/Upper PRM aquifer. The recent strata portion of the Recent/Upper PRM aquifer only exists where the Recent/Upper PRM aquifer has been exposed and reworked in the outcrop area. At the BROS Site, the Recent/Upper PRM aquifer is under water table conditions. However, south of Route I-295, the Recent/Upper PRM aquifer becomes confined between the basal silty-clay layer and the outcrop of the Merchantville Formation. The Recent/Upper PRM aquifer has been characterized to consist of three hydraulically-connected stratigraphic units including fill material, peat and sand in the alluvium, and sands of the Magothy Formation. The thickness of the Recent/Upper PRM aquifer ranges from 10 feet beneath the former lagoon area to greater than 100 feet beneath Swedesboro-Paulsboro Road. The mean hydraulic conductivity for the Recent/Upper PRM aquifer is 27 feet per day (ft/d) and the mean storage coefficient is 0.013, as determined by the aquifer test performed as part of the Phase 2 RI.

At the BROS Site, ground water flow patterns in the Recent/Upper PRM aquifer are driven by local topography and the dominant vertical flow direction in this recharge area. Excluding the effects of the lagoon backfill material, current horizontal ground water flow directions near the BROS property follow the regional flow patterns in the outcrop area of the Recent/Upper PRM aquifer. That is, ground water generally follows topography and discharges to local surface water bodies (Modica et al. 1997) or flows downward to recharge the Upper Middle PRM aquifer. Previous data (CH2M Hill, 1996) indicated that Gaventa Pond is a ground water discharge point during dry months but recharges the water table aquifer during the wet months of Spring, depending on the relative balance of evaporation and precipitation. Conversely, the CH_2M Hill data indicated that Swindell Pond maintained a higher water-level elevation than Gaventa Pond and recharged the Recent/Upper PRM aquifer throughout much of the year. However, water budget data gathered for the period from October 2000 through April 2001 during the Phase 2 RI indicated that the surface water level in Gaventa Pond was slightly lower than the ground water level both in adjacent Monitoring Well S-5, which is screened from 60 to 70 feet B.G.S., and in Gaventa Pond Piezometer PZ-1. The data also indicated that the surface water level in Swindell Pond was lower than the ground water level in adjacent water table Monitoring Well MW-23S and in Swindell Pond Piezometer PZ-2 from December 2000 through July 2001. The lower surface water levels in the ponds relative to the water table may be a local effect that reflects evaporation off the ponds surface, rather than indication of the ponds as discharge areas for shallow ground water.

In the downdip portion of the Upper PRM aquifer south of Route I-295, ground water flows to the southeast consistent with the regional flow direction along a horizontal gradient of 1.0×10^{-3} ft/ft. The vertical gradient within the Recent/Upper PRM aquifer was consistently downward (ranging between 1.1×10^{-2} ft/ft and 9.4×10^{-4} ft/ft).

The vertical gradient between the Recent/Upper PRM aquifer and the Upper Middle PRM aquifer was consistently downward in well clusters during the ground water elevation measurements (ranging from 7.1×10^{-2} ft/ft and 1.3×10^{-3} ft/ft).

2.2 Confining Layer Between Recent/Upper PRM and Upper Middle PRM Aquifers

Based on geologic and natural gamma logs for the site monitoring wells, the confining layer between the Recent/Upper PRM aquifer and Upper Middle PRM aquifer is continuous throughout the study area, except for a relatively small area beneath the BROS property. It is present in the north and northeastern portions of the BROS property and dips to the south-southeast. The thickness and characteristics of the confining layer vary across the BROS Site with a cumulative thickness of approximately 15 feet, consisting of stacked interbedded clays, beneath the southwest side of the former lagoon to a fining sequence of silts in monitoring wells in the southeast portions of the BROS property. South of the BROS property, the confining layer is continuous throughout the study area.

2.3 Upper Middle PRM Aquifer

Based on a review of soil boring log data and a constant-rate aquifer test performed during the Phase 2 RI, the Upper Middle PRM aquifer is a leaky confined aquifer beneath the BROS Site. A review of soil boring and gamma logs indicate that the Upper Middle PRM aquifer downdip of Route I-295 exists under confined conditions. This interpretation of the data is consistent with that of the New Jersey Geological Survey (Lewis *et al.*, 1991). The Upper Middle PRM aquifer is approximately 60 feet thick northwest of the former lagoon. Downdip of Route I-295, the thickness ranges from 30 to 60 feet, with the lower thickness observed in the vicinity of MW-16B.

Horizontal hydraulic gradients within the Upper Middle PRM aquifer range from an approximately 2.0×10^{-4} ft/ft near the former lagoon to 2.0×10^{-3} ft/ft near Swedesboro-Paulsboro Road. Vertical hydraulic gradients within the Upper Middle PRM aquifer are predominantly downward ranging between 2.1×10^{-2} ft/ft and 4.88×10^{-4} ft/ft. Aquifer transmissivities and hydraulic conductivities also increase in a downdip direction. The mean hydraulic conductivity for the Upper Middle PRM aquifer was determined to be 77.9 ft/d from the aquifer test performed in the Upper Middle PRM aquifer during the Phase 2 RI. The mean hydraulic conductivity in the wells screened at the upper and middle portions of the aquifer was 65.9 ft/d, while the mean hydraulic conductivity for the wells screened at the base of the aquifer was 100 ft/d.

The vertical gradient between wells within the Upper Middle PRM and the Lower Middle PRM aquifers was primarily downward in three well clusters ranging between 2.8 x 10^{-2} ft/ft and 7.0 x 10^{-3} ft/ft.

Ground water flow in the Upper Middle PRM aquifer is predominantly to the southeast due to regional ground water withdrawal from the aquifer. However, north of a ground water divide, which runs northeast to the southwest through the northern edge of the BROS property, ground water flows to the north towards the Delaware River.

3.0 SELECTION OF WRA COMPOUNDS

Constituents of potential concern were evaluated to determine those that would be used to define the extent of the WRA. Initially, all Phase 2 RI detections of COPCs in ground water were evaluated based on the following criteria:

- Presence of the COPCs in ground water at monitoring locations that indicate a tendency for significant migration downgradient of the Site (i.e., at locations southeast of Route I-295); and
- Presence of the COPCs in ground water southeast of Route I-295 at concentrations exceeding NJDEP GWQC.

Ground water quality data from the following wells southeast of Route I-295 were included in this evaluation (Figure A-1):

- MW-14A
- MW-14B
- MW-15A
- MW-15B
- MW-16A
- MW-16B
- MW-17I
- MW-17D
- MW-18D
- MW-19D
- MW-34D

A subset of the COPCs selected for further evaluation based on the above criteria was then selected for transport modeling. The criteria for this selection was based on a review of ground water quality data beneath and immediately adjacent to the BROS property in the following monitoring wells:

- MW-23D
- MW-26S
- MW-26I
- MW-26D
- MW-27D
- MW-32I
- MW-32D
- MW-4D
- S-11C

If relatively high concentrations were detected beneath or immediately adjacent to the BROS property (i.e., greater than 1 part per million [ppm]) in the above wells, then Roux Associates assumed that there was potentially a continuing source of that COPC to ground water. Mobile COPCs with a potentially continuing source represent the compounds most likely to migrate the farthest downgradient of Route I-295 in the future.

Based on the first of the above screening criteria, the following 18 organic compounds were selected for further evaluation to define the WRA:

Volatile Organic Compounds (VOCs)

- 1,1,2,2-tetrachloroethane
- 1,1,2-trichloroethane
- 1,1-dichloroethane
- 1,2-dichloroethane
- acetone
- benzene
- carbon disulfide
- chlorobenzene
- chloroform
- cis-1,2-dichloroethene
- tetrachloroethene
- trans-1,2-dichloroethene
- trichloroethene (TCE)
- vinyl chloride
- xylenes (total)

Semi-volatile Organic Compounds (SVOCs)

- bis(2-chloroethy)ether (BCEE)
- diethyl phthalate
- isophorone.

Based on the second criteria above, the following eight organic compounds were identified in wells southeast of Route I-295 at concentrations above NJDEP GWQC:

VOCs

- 1,1,2,2-tetrachloroethane
- 1,1-dichloroethane
- 1,2-dichloroethane
- benzene
- chloroform
- TCE
- vinyl chloride

SVOCs

- BCEE

Two of the above COPCs were detected in ground water beneath the BROS property at concentrations above 1 ppm: BCEE and TCE. Therefore, these two compounds were selected for transport modeling. Benzene was included in transport modeling as a third COPC because the concentrations beneath the BROS property were close to 1 ppm (960 micrograms per liter [µg/L] in MW-23D and 950 µg/L in MW-32S). Therefore, the limits of the WRA are defined based on the current and predicted distribution of benzene, BCEE, and TCE.

3.1 Distribution of Benzene, BCEE, and TCE

The current distribution of benzene, BCEE and TCE in both the Recent/Upper PRM and Upper Middle PRM aquifers was established based upon ground water quality data obtained during the sampling performed for the Phase 2 RI for the BROS Site (Table 1). Isoconcentrations contours depicting the distribution of benzene, BCEE, and TCE, based on the Phase 2 RI ground water quality data and used as initial concentrations in the transport modeling, are presented in Figures A-2, A-3, and A-4.

4.0 MODELING TO PREDICT THE FUTURE DISTRIBUTION AND DURATION OF WELL RESTRICTION AREAS

Ground water flow and fate and transport modeling were performed to predict the future distribution and duration of the WRAs for benzene, BCEE, and TCE in the Recent/Upper PRM and Upper Middle PRM aquifers. Consistent with the United States Environmental Protection Agency (USEPA)-approved Work Plan (Roux, 1998) and NJDEP guidance (NJDEP, 1998), a three-dimensional numerical ground water flow and fate and transport model was prepared and calibrated as part of the scope of work for the Phase 2 RI. A brief summary of the model setup, calibration and transport parameters used is provided below and a more detailed summary will be provided in the Remedial Investigation Report.

4.1 Model Codes

The ground water flow component of the model was performed using MODFLOW. The transport component of the model was performed using MT3D. Both model codes are widely-used, well-tested, industry and government accepted standards for this purpose.

4.2 Model Grid

The MODFLOW model grid consisted of 12 layers and 284,160 cells. A plan view of the model grid is provided in Figure A-5. Layers 1 though 5 represent the Recent/Upper PRM aquifer. Layers 6 through 8 represent the confining unit between the Recent/Upper PRM and the Upper Middle PRM aquifers. Layers 9 through 12 represent the Upper Middle PRM aquifer. The bottom of the model was defined based on the elevation of the top of the confining layer between the Upper Middle PRM and Lower Middle PRM aquifers.

4.3 Model Grid Parameters

Parameters input into the model grid include recharge, hydraulic conductivity, effective porosity, dispersivity, distribution coefficient (Kd), biodegredation rate constant, and bulk density. Emphasis was placed on using empirical Site data for parameter input.

4.3.1 Recharge

Initially, recharge was set at long-term regional average based on National Oceanic and Atmospheric Administration (NOAA) data. Recharge was varied using zones during calibration

process. The average recharge rate used in the model (15 inches per year) agree with empirical site-specific water budget data obtained during performance of the Phase 2 RI.

4.3.2 Hydraulic Conductivity

Hydraulic conductivity values for the model were obtained based on aquifer-specific pumping test data, slug test data, United States Geologic Survey (USGS) data and literature values for material descriptions. A hydraulic conductivity scale was developed for each aquifer material description in the geologic logs obtained from previous investigations and the Phase 2 RI. The hydraulic conductivity data was contoured in Surfer for each layer and imported into model grid. The hydraulic conductivity values were then further modified by zones during the calibration process.

The hydraulic conductivities used to represent the Recent/Upper PRM aquifer ranged from 0.01 ft/d to 200 ft/d. Most of the Recent/Upper PRM aquifer in the model was represented with hydraulic conductivity zones ranging from 20 ft/d to 60 ft/d. The hydraulic conductivities used to represent the confining clay unit between the Recent/Upper PRM and Upper Middle PRM aquifers ranged from 0.01 ft/d to 0.05 ft/d. The hydraulic conductivities used to represent the Upper Middle PRM aquifer ranged from 0.01 ft/d to 200 ft/d. Most of the Upper Middle PRM aquifer in the model was represented with hydraulic conductivity zones ranging from 30 ft/d to 140 ft/d. These values were consistent with data obtained during aquifer pumping tests of the Recent/Upper PRM aquifer and the Upper Middle PRM aquifer performed during the Phase 2 RI.

4.3.3 Effective Porosity

The average effective porosity of 0.19 or 19 percent for the model was calculated based on porosity and moisture content data for numerous aquifer solids samples obtained during the Phase 2 RI and analyzed using American Society for Testing and Materials (ASTM) Method D2216 and United States Army Corps of Engineers methodologies . The effective porosity was calculated to equal the difference between the porosity and the moisture content of the solids samples from the BROS Site.

4.3.4 Dispersivity

A longitudinal dispersivity of 18 ft was calculated assuming a plume length of 4,000 feet and the following relation (Xu and Eckstein, 1995):

$$A_x = 0.83(\log_{10} L)^{2.414}$$

Where,

A_x = longitudinal dispersivity (feet)

L = plume length (feet)

The transverse dispersivity of 6 feet was calculated as 0.33 A_x (USEPA, 1986; ASTM, 1995). The vertical dispersivity was based on flow model calibration and was set equal to 0.4 feet.

4.3.5 Distribution Coefficient

The distribution coefficient (Kd), from which the retardation factor was calculated by the model, was obtained using empirical total organic carbon (TOC) data obtained during the Phase 2 RI, and empirical relationships using the octanol-water partition coefficients (K_{ow}) to derive the organic carbon partition coefficients (K_{oc}) (Spitz and Moreno, 1996). Distribution coefficients for the Recent/Upper PRM aquifer ranged from 0.002 to 12.09 milliliters per gram (ml/g). Distribution coefficients for the Upper Middle PRM aquifer ranged from 0.001 ml/g to 0.08 ml/g. Based upon the low Kd values derived for the Upper Middle PRM aquifer, retardation is predicted to play less of a role in transport southeast of the BROS property than beneath the property in the Recent/Upper PRM aquifer. This conclusion is supported by the co-occurrence of several COPCs at similar concentrations in wells southeast of Route I-295, despite up to five orders of magnitude different K_{oc} values.

4.3.6 Bulk Density

Bulk density was calculated based on porosities measured in nine aquifer sand samples and four clay confining unit samples. The average porosity of the aquifer sand samples was 35 percent and the average porosity of the clay samples was 39 percent. Assuming a density of the matrix of 2.65 grams per cubic centimeter (g/cm^3 [Freeze and Cherry, 1979]) yields a bulk density for the aquifer of 1.7 g/cm^3 and a bulk density of the clay aquitard of 1.6 g/cm^3.

5.0 FLOW MODEL CALIBRATION

Flow model calibration was achieved using both iterative trial and error and automated sensitivity analyses to achieve the lowest target residuals.

5.1 Calibration Target Heads

The calibration target heads for the MODFLOW ground water flow model were based on the November 2000 synoptic water level round performed at the BROS Site. Evaluation of additional water level rounds indicated similar ranges in hydraulic heads and gradients. A summary of calibration target head residuals by layer and for the whole model is shown in Table A-2. The results of the calibration were evaluated by use of the residual mean and absolute residual mean as calibration criteria. These criteria compare the modeled hydraulic heads with the actual measured hydraulic heads in monitoring wells and piezometers. The goal of the calibration process is to reduce the residual and absolute residual mean to the extent practicable. Typically, numbers below 1 foot indicate a good calibration. However, for the BROS Site, the water level range is only approximately one to two feet. Therefore, the goal of the calibration process was residual and absolute residual means significantly less than 1 foot. The residual mean (average of the difference between modeled and observed hydraulic heads) for the whole model was –0.16 feet with an observed range in hydraulic head of 24.7 feet. The absolute residual mean (average of the absolute value of the difference between modeled and observed hydraulic heads) for the whole model was 0.34 feet.

6.0 TRANSPORT MODEL PARAMETERS

Based on concentrations, mobility and downgradient distribution, transport modeling of benzene, BCEE, and TCE were used to define the extent of the WRA. To perform the transport modeling, a representation of the current extent and concentrations (i.e., initial concentrations) of these three compounds was created in the model grid based on the distribution established from recent Phase 2 RI data (Figures A-2, A-3, and A-4). The model grid also contained constant source boundary conditions to represent the continuous input of chemical mass in both the Recent/Upper PRM and Upper Middle PRM aquifers.

6.1 Initial Concentrations

Initial concentrations were based on Phase 2 RI ground water quality data. The data were imported into Surfer, contoured and imported into the model grid. Separate model grids were used for benzene, BCEE, and TCE. The resulting mass distribution in the model was checked at each target location by comparing concentrations as represented in the model with actual measured concentrations.

6.2 Constant Sources

Constant sources were defined in the Recent/Upper PRM and Upper Middle PRM aquifers using constant concentration boundary conditions in the model grid. The concentrations assigned to the boundary cells were defined based on an examination of hot spots in the Recent/Upper PRM and Upper Middle PRM aquifers. The hot spots are located in a ground water recharge area, where the primary direction of ground water movement is vertically downward. The assumption employed to use the boundary conditions as constant sources was that for the hot spots to persist, there must be a source in the aquifer that is adding dissolved mass at a concentration equal to that in the hot spot. Therefore, the concentration assigned to constant source boundary condition cells was set equal to the concentrations in ground water in each hot spot. This assumption is conservative in that the adsorbed masses in source areas are decreasing with time via dissolution and decay, and additional remediation will occur. Consequently, there is a high degree of confidence that the model outputs will not underestimate the future distribution of BROS-related chemicals of concern.

6.3 Biodegradation Rate Constants

First-order biodegradation of benzene, BCEE, and TCE was assumed for the transport modeling consistent with relevant literature and agency guidance (Wiedemeier *et al.*, 1999). In accordance with USEPA guidance, first-order biodegradation rate constants were estimated based on data available in the *"Handbook of Environmental Degradation Rates"* (Howard *et al.*, 1991).

Biodegradation rates were input into the model grid based on zones. The biodegradation rate chosen for each zone was based on a review of ground water quality data obtained during the Phase 2 RI, including COPC concentration, dissolved oxygen (DO), oxygen reduction potential (ORP), dissolved iron, and the presence of biodegradation daughter products and pH.

Three different zones for input of biodegradation rate constants were used in the model grid:

- *Zone 1: Recharge area for Recent/Upper PRM aquifer beneath BROS property*
  Characterized as predominantly aerobic, with low to moderate concentrations of COPCs (0.5 to 2 ppm) and a pH of 4.5 to 6.5. TCE degradation daughter products present. Average aerobic biodegradation rates were used for this zone.

- *Zone 2: Base of Upper Middle PRM aquifer beneath BROS property and extending southeast to Route I-295*
  Characterized by a transition in DO from aerobic near the BROS property to anaerobic near Route I-295; with high concentrations of COPCs (up to 10 ppm) and pH ranging from 4.0 down to 2.5. It was assumed that due to high COPC concentrations and low pH, biodegradation rates were very slow to minimal. The maximum biodegradation half-life reported in the literature for each modeled COPC was used in this zone.

- *Zone 3: Base of Upper Middle PRM aquifer south of Route I-295*
  Characterized as anaerobic to anoxic, with pH ranging from 5.0 to 7.5, and low concentrations of COPCs (up to 0.5 ppm). Due to the low total organic carbon and low COPC concentrations present in the aquifer in this zone, slow biodegradation rates were assumed for benzene, toluene, ethylbenzene, and xylene (BTEX) compounds. The maximum biodegradation half-life reported in the literature for benzene was used in the model in Zone 3. The presence of TCE daughter products, including vinyl chloride, suggested that TCE degradation is occurring in this zone. Therefore, a biodegradation half-life between the slowest anaerobic rate and the average aerobic rate reported in the literature for TCE was used. For BCEE, the maximum biodegradation half-life reported in the literature was used.

The table below summarizes the first-order biodegradation half-lives used in the model for each zone described above:

Model Zone	Benzene	BCEE	TCE
1	73 days	182 days	321 days
2	730 days	365 days	1,653 days
3	730 days	365 days	500 days

As discussed above, the maximum biodegradation half-life (i.e., slowest biodegradation rate) reported in the literature was used in the transport model for benzene and BCEE in Zones 1 and 2, and for TCE in Zone 2. Use of the maximum biodegradation half-life maximizes the model-predicted extent of each COPC, and is justified based on the assumption that biodegradation in a portion of this zone may be precluded or inhibited by the low pH observed in groundwater during the Phase 2 RI.

Use of a low biodegradation rate (i.e., long half-life) results in a conservatively large WRA based on the model results that is biased towards greater predicted longevity than is likely to occur. Please note that transport modeling performed as part of future remedial alternatives screening for the Feasibility Study may employ more realistic (i.e., faster) biodegradation rates as justified based on site-specific empirical data, values reported in the literature, and generally-accepted modeling practices.

7.0 TRANSPORT MODEL RESULTS

COPC transport simulations were performed using the calibrated groundwater flow model, the modeled representations of the extent of benzene, BCEE and TCE in the Recent/Upper and Upper Middle PRM aquifers, and the constant sources as described in Section 6.2 above.

The transport simulations involved performing model runs for up to 30 simulated years, or until steady state was reached, allowing for only degradation to reduce COPC concentrations with time. Simulations were run individually for each of the three model grids set up with initial concentrations of benzene, BCEE and TCE. The results of the MT3D model simulations are presented in Plate A-1, showing model output concentrations both the Recent/Upper PRM and Upper Middle PRM aquifers. Layer 5 was chosen as representative of the Recent/Upper PRM and Layer 12 as representative of the base of the Upper Middle PRM.

Benzene

A review of Plate A-1 indicates that there is no predicted further horizontal transport of benzene in the Recent/Upper PRM aquifer downgradient of the BROS property. This is due to a combination of two factors:

- The predominantly downward hydraulic gradient beneath the BROS property; and
- A half-life of 73 days that is relatively short compared to the simulation times.

The output of the model simulation for the base of the Upper Middle PRM (Layer 12) indicates that the benzene plume is currently either at close to its maximum extent or in a shrinking phase. Even with a degradation half-life of 730 days, benzene concentrations south of I-295 are below 10 µg/L after ten simulated years. After 15 simulated years, concentrations are below NJDEP GWQC.

BCEE

A review of Plate A-1 indicates that the horizontal transport of BCEE in the Recent/Upper PRM mimics observations made for benzene, with no migration in the aquifer downgradient of the BROS property. Similarly, the output of the model simulation for the base of the Upper Middle PRM (Layer 12) indicates that the BCEE plume is also currently either at close to its maximum

extent or in a shrinking phase. With a degradation half-life of 365 days, BCEE concentrations south of I-295 are below 100 µg/L after five simulated years. After 10 simulated years, a steady-state has been reached between input of BCEE from the constant sources and degradation of BCEE. This steady-state is reflected by a plume that does not changes in concentration or extent during the final ten years of the simulation. Note that under the natural attenuation scenario, BCEE has degraded almost everywhere at the base of the Upper Middle PRM south of I-295 to concentrations at or below 1 µg/L.

TCE

The transport of TCE relative to both BCEE and benzene reflects the longer degradation half life used for TCE in the model relative to the other two compounds. In the Recent/Upper PRM aquifer, the plume of TCE persists south of the BROS property line, but does not extend south of I-295.

In the Upper Middle PRM aquifer (model Layer 12), the width of the TCE plume downgradient (i.e., south) of I-295 decreases. However, the location and concentrations of the leading edge of the plume remain relatively static. A steady-state is reached between input of TCE from the source areas and degradation shortly after 10 simulated years. Concentrations over 100 µg/L persist immediately south of I-295.

The relatively greater extent of TCE persisting south of I-295, compared to both BCEE and benzene, reflects the long half-life of 1,653 days used for TCE in the source area beneath the BROS property. Note also that the location of the highest concentrations of TCE (MW-23D and S-11C) are closer to I-295 that the locations of the highest concentrations of BCEE (MW-26D and MW-27D). Therefore, the modeled plume of TCE will have a tendency over time to extend farther south of the BROS property that the BCEE plume.

Based on the results of the transport simulations, the plumes of benzene, BCEE, and TCE are currently either at their maximum extent or in shrinking modes. The benzene plume is predicted to shrink more rapidly in the future due to higher biodegradation rates. This suggests that based on available data obtained during the Phase 2 RI, and conservatively slow estimates of

biodegradation rates, the current distribution of benzene, BCEE, and TCE in ground water is the maximum predicted and the plumes will continue to shrink in the future.

7.1 Boundary of the WRAs

The predicted boundary of the WRA was mapped by superimposing the current plumes of all eight mobile compounds detected in the Upper Middle PRM aquifer south of Route I-295. The updated boundaries of the WRAs are provided in Figures A-6 and A-7 for the Recent/Upper PRM and Upper Middle PRM aquifers, respectively. As discussed, the WRA boundaries are predicted to be the maximum extent of the WRAs based on numerical transport modeling.

7.2 Duration of the WRAs

Based on the results of the transport modeling, with the exception of in the immediate vicinity of the BROS property, benzene will reach concentrations below the NJDEP GWQC of 1 µg/L in the Upper PRM within 10 years and everywhere, except at the base of the Upper Middle PRM beneath the BROS property, within 17 years.

The results of the model predict that BCEE will remain at concentrations above NJDEP GWQC of 10 µg/L in the Recent/Upper Middle PRM beneath the BROS property as long as source areas persist. However, at the base of the Upper Middle PRM southeast of Route I-295, BCEE will be below the NJDEP GWQC within seven years; reflecting the shorter biodegradation half-life used in the model for Zone 3.

The TCE transport modeling predicts that TCE will persist in the Recent/Upper Middle PRM aquifer beneath the BROS property as long as source areas are active. Moreover, it may take approximately 20 years for TCE to decrease in concentration to below the NJDEP GWQC of 1 µg/L at the base of the Upper Middle PRM aquifer south of the BROS property. However, substantial additional remedial action will be implemented to further remove source material and decrease the mobility, toxicity, and volume of BROS-related chemicals above NJDEP GWQC. Consequently, the rate of aquifer restoration will be enhanced significantly but can not be predicted until a remedial program is selected by the USEPA, in consultation with NJDEP.

8.0 REFERENCES

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Table 1. Summary of Round 4 Groundwater Quality Data for Compounds Used to Define Well Restriction Area. BROS Superfund Site; Logan Township, New Jersey.

Designation	Analyte	Date Sampled	Concentration	Unit	Lab Qualifier	Easting	Northing
MW-4A	1,1,2,2-Tetrachloroethane	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	260642.92	353196.39
MW-7A	1,1,2,2-Tetrachloroethane	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	1,1,2,2-Tetrachloroethane	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	1,1,2,2-Tetrachloroethane	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	1,1,2,2-Tetrachloroethane	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	262475.45	352621.66
MW-12B	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	262277.68	352303.71
MW-16B	1,1,2,2-Tetrachloroethane	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	263072.14	351289.96
MW-18D	1,1,2,2-Tetrachloroethane	06/11/01	9	ug/l		263793.29	352746.74
MW-19D	1,1,2,2-Tetrachloroethane	05/01/01	1	ug/l	U	264044.04	353450.14
MW-22D	1,1,2,2-Tetrachloroethane	05/03/01	25	ug/l		262734.92	353044.04
MW-23D	1,1,2,2-Tetrachloroethane	05/04/01	51	ug/l		261887.38	353067.83
MW-23I	1,1,2,2-Tetrachloroethane	05/04/01	1	ug/l	U	261882.30	353072.93
MW-23S	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	261878.11	353076.94
MW-26D	1,1,2,2-Tetrachloroethane	05/04/01	2	ug/l	U	261639.27	353498.27
MW-26I	1,1,2,2-Tetrachloroethane	05/04/01	1	ug/l	U	261648.21	353495.40
MW-26S	1,1,2,2-Tetrachloroethane	05/03/01	1	ug/l	U	261646.40	353502.54
MW-32D	1,1,2,2-Tetrachloroethane	05/03/01	11	ug/l		261434.43	353870.74
MW-32I	1,1,2,2-Tetrachloroethane	05/03/01	3	ug/l	U	261462.11	353896.18
MW-33D	1,1,2,2-Tetrachloroethane	06/11/01	1	ug/l	U	261081.05	351106.34
MW-34D	1,1,2,2-Tetrachloroethane	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	1,1,2,2-Tetrachloroethane	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	1,1,2,2-Tetrachloroethane	05/01/01	1	ug/l	U	262063.79	353396.31
S-11C	1,1,2,2-Tetrachloroethane	05/04/01	10	ug/l	U	261908.12	353505.06
S-4	1,1,2,2-Tetrachloroethane	04/30/01	1	ug/l	U	260649.64	353209.63
MW-4A	1,2-Dichloroethane	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	1,2-Dichloroethane	05/02/01	6	ug/l		260642.92	353196.39
MW-7A	1,2-Dichloroethane	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	1,2-Dichloroethane	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	1,2-Dichloroethane	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	1,2-Dichloroethane	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	1,2-Dichloroethane	05/02/01	10	ug/l		262475.45	352621.66
MW-12B	1,2-Dichloroethane	05/02/01	1	ug/l	U	262277.68	352303.71
MW-16B	1,2-Dichloroethane	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	1,2-Dichloroethane	05/02/01	28	ug/l		263072.14	351289.96
MW-18D	1,2-Dichloroethane	06/11/01	7	ug/l		263793.29	352746.74
MW-19D	1,2-Dichloroethane	05/01/01	1	ug/l	U	264044.04	353450.14
MW-22D	1,2-Dichloroethane	05/03/01	40	ug/l		262734.92	353044.04
MW-23D	1,2-Dichloroethane	05/04/01	230	ug/l		261887.38	353067.83
MW-23I	1,2-Dichloroethane	05/04/01	1	ug/l	U	261882.30	353072.93
MW-23S	1,2-Dichloroethane	05/02/01	5	ug/l	J	261878.11	353076.94
MW-26D	1,2-Dichloroethane	05/04/01	270	ug/l		261639.27	353498.27
MW-26I	1,2-Dichloroethane	05/04/01	1	ug/l	U	261648.21	353495.40
MW-26S	1,2-Dichloroethane	05/03/01	140	ug/l		261646.40	353502.54
MW-32D	1,2-Dichloroethane	05/03/01	71	ug/l		261434.43	353870.74
MW-32I	1,2-Dichloroethane	05/03/01	3	ug/l	U	261462.11	353896.18
MW-33D	1,2-Dichloroethane	06/11/01	1	ug/l	U	261081.05	351106.34
MW-34D	1,2-Dichloroethane	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	1,2-Dichloroethane	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	1,2-Dichloroethane	05/01/01	1	ug/l	U	262063.79	353396.31
S-11C	1,2-Dichloroethane	05/04/01	180	ug/l		261908.12	353505.06
S-4	1,2-Dichloroethane	04/30/01	1	ug/l	U	260649.64	353209.63

Table 1. Summary of Round 4 Groundwater Quality Data for Compounds Used to Define Well Restriction Area. BROS Superfund Site; Logan Township, New Jersey.

Designation	Analyte	Date Sampled	Concentration	Unit	Lab Qualifier	Easting	Northing
MW-4A	Benzene	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	Benzene	05/02/01	21	ug/l		260642.92	353196.39
MW-7A	Benzene	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	Benzene	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	Benzene	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	Benzene	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	Benzene	05/02/01	13	ug/l		262475.45	352621.66
MW-12B	Benzene	05/02/01	6	ug/l		262277.68	352303.71
MW-16B	Benzene	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	Benzene	05/02/01	36	ug/l		263072.14	351289.96
MW-18D	Benzene	06/11/01	7	ug/l		263793.29	352746.74
MW-19D	Benzene	05/01/01	1	ug/l	J	264044.04	353450.14
MW-22D	Benzene	05/03/01	21	ug/l		262734.92	353044.04
MW-23D	Benzene	05/04/01	480	ug/l		261887.38	353067.83
MW-23I	Benzene	05/04/01	1	ug/l	J	261882.30	353072.93
MW-23S	Benzene	05/02/01	3	ug/l	J	261878.11	353076.94
MW-26D	Benzene	05/04/01	510	ug/l		261639.27	353498.27
MW-26I	Benzene	05/04/01	390	ug/l	D	261648.21	353495.40
MW-26S	Benzene	05/03/01	280	ug/l		261646.40	353502.54
MW-32D	Benzene	05/03/01	96	ug/l		261434.43	353870.74
MW-32I	Benzene	05/03/01	520	ug/l		261462.11	353896.18
MW-33D	Benzene	06/11/01	1	ug/l	U	261081.05	351106.34
MW-34D	Benzene	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	Benzene	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	Benzene	05/01/01	2	ug/l	J	262063.79	353396.31
S-11C	Benzene	05/04/01	520	ug/l		261908.12	353505.06
S-4	Benzene	04/30/01	1	ug/l	U	260649.64	353209.63
MW-4A	Chloroform	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	Chloroform	05/02/01	1	ug/l	U	260642.92	353196.39
MW-7A	Chloroform	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	Chloroform	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	Chloroform	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	Chloroform	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	Chloroform	05/02/01	1	ug/l	U	262475.45	352621.66
MW-12B	Chloroform	05/02/01	1	ug/l	U	262277.68	352303.71
MW-16B	Chloroform	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	Chloroform	05/02/01	13	ug/l		263072.14	351289.96
MW-18D	Chloroform	06/11/01	1	ug/l	U	263793.29	352746.74
MW-19D	Chloroform	05/01/01	1	ug/l	U	264044.04	353450.14
MW-22D	Chloroform	05/03/01	1	ug/l	U	262734.92	353044.04
MW-23D	Chloroform	05/04/01	32	ug/l	J	261887.38	353067.83
MW-23I	Chloroform	05/04/01	1	ug/l	U	261882.30	353072.93
MW-23S	Chloroform	05/02/01	1	ug/l	U	261878.11	353076.94
MW-26D	Chloroform	05/04/01	29	ug/l		261639.27	353498.27
MW-26I	Chloroform	05/04/01	1	ug/l	U	261648.21	353495.40
MW-26S	Chloroform	05/03/01	15	ug/l		261646.40	353502.54
MW-32D	Chloroform	05/03/01	1	ug/l	U	261434.43	353870.74
MW-32I	Chloroform	05/03/01	25	ug/l		261462.11	353896.18
MW-33D	Chloroform	06/11/01	1	ug/l	U	261081.05	351106.34
MW-34D	Chloroform	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	Chloroform	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	Chloroform	05/01/01	1	ug/l	U	262063.79	353396.31
S-11C	Chloroform	05/04/01	60	ug/l		261908.12	353505.06
S-4	Chloroform	04/30/01	1	ug/l	U	260649.64	353209.63

Table 1. Summary of Round 4 Groundwater Quality Data for Compounds Used to Define Well Restriction Area. BROS Superfund Site; Logan Township, New Jersey.

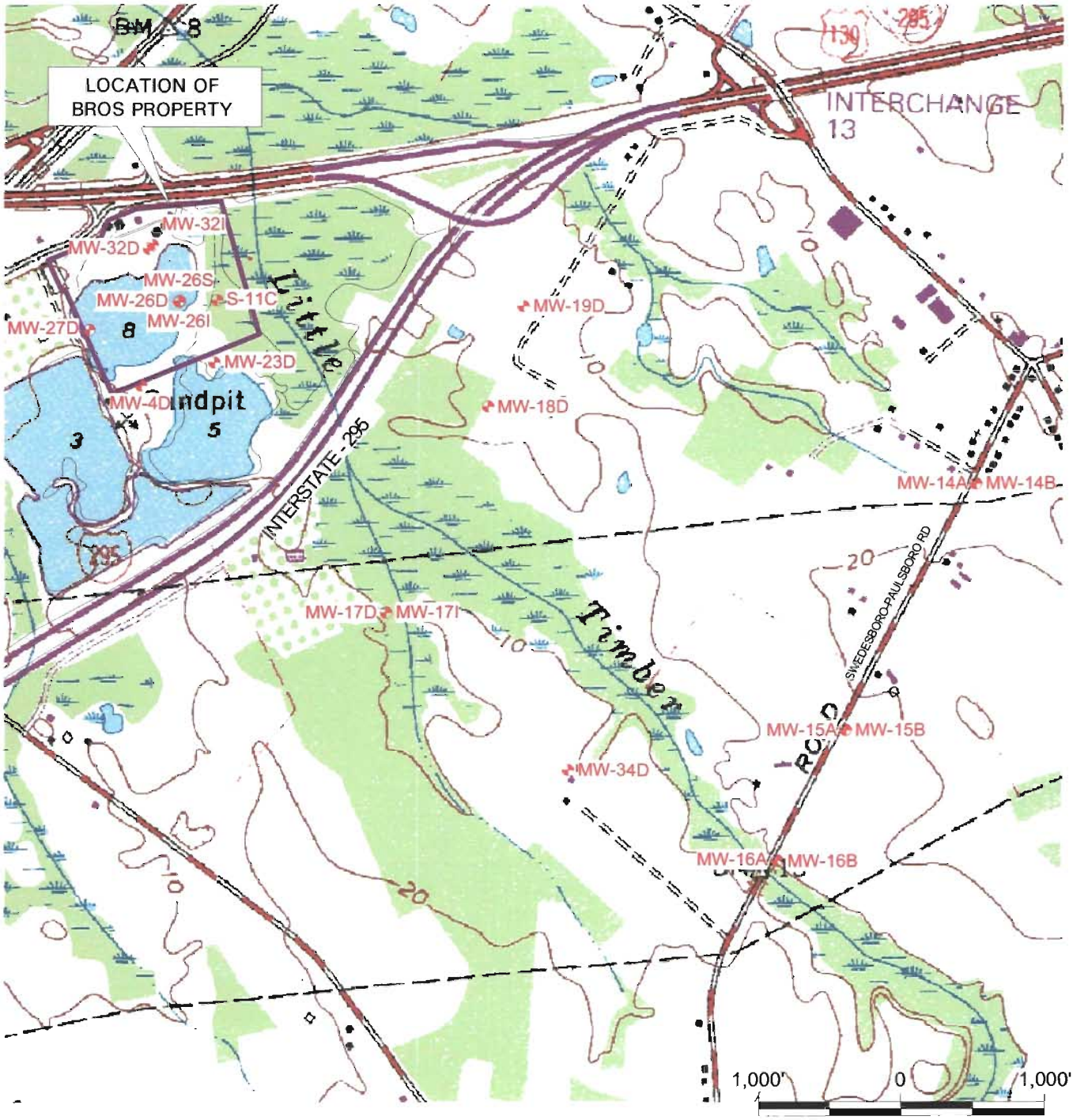
Designation	Analyte	Date Sampled	Concentration	Unit	Lab Qualifier	Easting	Northing
MW-4A	Trichloroethene	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	Trichloroethene	05/02/01	160	ug/l		260642.92	353196.39
MW-7A	Trichloroethene	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	Trichloroethene	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	Trichloroethene	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	Trichloroethene	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	Trichloroethene	05/02/01	52	ug/l		262475.45	352621.66
MW-12B	Trichloroethene	05/02/01	19	ug/l		262277.68	352303.71
MW-16B	Trichloroethene	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	Trichloroethene	05/02/01	54	ug/l		263072.14	351289.96
MW-18D	Trichloroethene	06/11/01	21	ug/l		263793.29	352746.74
MW-19D	Trichloroethene	05/01/01	1	ug/l	U	264044.04	353450.14
MW-22D	Trichloroethene	05/03/01	240	ug/l		262734.92	353044.04
MW-23D	Trichloroethene	05/04/01	2200	ug/l		261887.38	353067.83
MW-23I	Trichloroethene	05/04/01	1	ug/l	U	261882.30	353072.93
MW-23S	Trichloroethene	05/02/01	1	ug/l	U	261878.11	353076.94
MW-26D	Trichloroethene	05/04/01	1600	ug/l	D	261639.27	353498.27
MW-26I	Trichloroethene	05/04/01	1	ug/l	U	261648.21	353495.40
MW-26S	Trichloroethene	05/03/01	430	ug/l	D	261646.40	353502.54
MW-32D	Trichloroethene	05/03/01	30	ug/l		261434.43	353870.74
MW-32I	Trichloroethene	05/03/01	13	ug/l		261462.11	353896.18
MW-33D	Trichloroethene	06/11/01	5	ug/l		261081.05	351106.34
MW-34D	Trichloroethene	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	Trichloroethene	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	Trichloroethene	05/01/01	1	ug/l	U	262063.79	353396.31
S-11C	Trichloroethene	05/04/01	5300	ug/l	D	261908.12	353505.06
S-4	Trichloroethene	04/30/01	1	ug/l	U	260649.64	353209.63
MW-4A	Vinyl chloride	04/30/01	1	ug/l	U	261378.43	352924.02
MW-5B	Vinyl chloride	05/02/01	23	ug/l		260642.92	353196.39
MW-7A	Vinyl chloride	04/30/01	1	ug/l	U	260682.30	354350.58
MW-8A	Vinyl chloride	05/01/01	1	ug/l	U	261455.00	354404.88
MW-8B	Vinyl chloride	05/01/01	1	ug/l	U	261454.04	354399.19
MW-9B	Vinyl chloride	04/30/01	1	ug/l	U	261871.69	354391.41
MW-11B	Vinyl chloride	05/02/01	6	ug/l		262475.45	352621.66
MW-12B	Vinyl chloride	05/02/01	3	ug/l	J	262277.68	352303.71
MW-16B	Vinyl chloride	05/01/01	1	ug/l	U	265790.76	349523.58
MW-17D	Vinyl chloride	05/02/01	18	ug/l		263072.14	351289.96
MW-18D	Vinyl chloride	06/11/01	1	ug/l	U	263793.29	352746.74
MW-19D	Vinyl chloride	05/01/01	1	ug/l	U	264044.04	353450.14
MW-22D	Vinyl chloride	05/03/01	4	ug/l	J	262734.92	353044.04
MW-23D	Vinyl chloride	05/04/01	35	ug/l	J	261887.38	353067.83
MW-23I	Vinyl chloride	05/04/01	1	ug/l	U	261882.30	353072.93
MW-23S	Vinyl chloride	05/02/01	1	ug/l	U	261878.11	353076.94
MW-26D	Vinyl chloride	05/04/01	59	ug/l		261639.27	353498.27
MW-26I	Vinyl chloride	05/04/01	1	ug/l	U	261648.21	353495.40
MW-26S	Vinyl chloride	05/03/01	26	ug/l		261646.40	353502.54
MW-32D	Vinyl chloride	05/03/01	7	ug/l		261434.43	353870.74
MW-32I	Vinyl chloride	05/03/01	94	ug/l		261462.11	353896.18
MW-33D	Vinyl chloride	06/11/01	1	ug/l	U	261081.05	351106.34
MW-34D	Vinyl chloride	05/02/01	1	ug/l	U	264336.43	350170.02
MW-35D	Vinyl chloride	05/04/01	1	ug/l	U	265333.12	351421.24
MW-36S	Vinyl chloride	05/01/01	1	ug/l	U	262063.79	353396.31
S-11C	Vinyl chloride	05/04/01	49	ug/l	J	261908.12	353505.06
S-4	Vinyl chloride	04/30/01	1	ug/l	U	260649.64	353209.63

Table 2. Summary of Flow Model Calibration Statistics. BROS Superfund Site; Logan Township, New Jersey.

Designation	Easting	Northing	Layer	Observed	Computed	Residual		
15-144	1694.63	15548.45	8	-4.00	-0.75	-3.25	Residual Mean	-0.07
15-147	11035.09	15790.64	3	4.00	0.91	3.09	Res. Std. Dev.	1.27
15-240	9304.70	2857.82	8	-20.00	-28.28	8.28	Sum of Squares	164.62
15-345	15421.42	9971.90	2	-12.00	-13.01	1.01	Abs. Res. Mean	0.34
15-395	21291.69	15598.39	9	-2.00	-4.35	2.35	Min. Residual	-3.48
15-540	15029.23	19698.50	12	2.00	2.18	-0.18	Max. Residual	8.28
15-546	13941.51	20176.51	4	2.00	2.92	-0.92	Range	24.70
15-569	1875.08	10605.48	11	-7.00	-11.16	4.16	Std/Range	0.05
15-573	7699.00	19094.32	1	3.00	2.80	0.20		
15-585	6636.08	18305.93	9	-1.00	0.99	-1.99		
15-613	6684.45	18552.95	3	1.00	2.11	-1.11		
15-614	7400.31	19423.89	1	2.00	2.38	-0.38		
15-617	11796.63	11657.15	3	-11.77	-8.29	-3.48		
15-707	15029.23	19698.50	1	2.00	2.30	-0.30		
15-713	23956.36	14707.33	12	-6.35	-5.97	-0.38		
15-728	23956.36	14707.33	4	-2.35	-4.86	2.51		
EPA-101	15836.87	18488.65	4	2.57	3.14	-0.57		
EPA-102	15610.77	19377.73	4	2.44	2.65	-0.21		
EPA-103	15621.66	19945.04	9	1.27	2.15	-0.88		
EPA-104S	15943.90	19799.25	4	2.39	2.36	0.03		
EPA-107	16978.28	20210.56	9	2.15	2.59	-0.44		
GM95-MW2S	14164.02	21441.10	5	2.73	2.41	0.32		
GM95-MW4I	12350.43	19481.86	12	2.32	2.60	-0.28		
GM95-MW4S	12356.99	19494.09	3	2.40	3.14	-0.74		
GM95-MW5I	12800.81	18899.53	9	2.26	2.44	-0.18		
GM95-MW5S	12806.54	18893.52	4	2.29	3.18	-0.89		
GM95-MW6I	13732.64	18029.18	12	1.40	1.52	-0.12		
GM95-MW6S	13730.00	18038.01	3	1.66	2.78	-1.12		
GM95-MW7S	14946.43	19441.22	5	1.50	2.41	-0.91		
MW-10A	17704.71	17968.54	1	1.93	2.44	-0.51		
MW-10B	17706.38	17980.20	12	0.73	0.68	0.05		
MW-11A	16826.59	17876.59	1	3.58	3.48	0.10		
MW-11A(D)	16828.98	17811.77	5	1.09	3.35	-2.26		
MW-11B	16822.91	17868.75	12	1.37	0.91	0.46		
MW-12A	16483.89	17781.51	1	2.49	3.61	-1.12		
MW-12B	16483.88	17709.80	12	1.35	0.90	0.45		
MW-14A	20534.35	14941.11	5	-4.66	-4.26	-0.40		
MW-14B	20537.31	14935.87	12	-5.59	-5.04	-0.55		
MW-15A	18821.79	13982.78	5	-4.64	-5.27	0.63		
MW-15B	18824.35	13976.33	12	-5.92	-6.10	0.18		
MW-16A	17913.60	13469.57	5	-5.89	-5.86	-0.03		
MW-16B	17916.03	13464.83	12	-6.22	-6.87	0.65		
MW-17D	16598.04	16426.91	12	-0.98	-0.76	-0.22		
MW-18D	17996.27	17255.90	12	-0.49	-0.42	-0.07		
MW-19D	18589.66	17709.25	12	-0.29	-0.14	-0.15		
MW-1A	16842.62	18951.39	1	3.89	3.49	0.40		
MW-21D	17803.34	18228.08	12	0.96	0.97	-0.01		
MW-22D	17154.80	18024.44	12	0.89	0.94	-0.05		
MW-22I	17272.25	18091.94	11	1.36	1.02	0.34		
MW-22S	17263.55	18087.44	1	3.91	3.09	0.82		
MW-23D	16572.71	18563.22	12	1.66	1.57	0.09		
MW-23I	16571.23	18570.27	9	1.88	1.70	0.18		

Table 2. Summary of Flow Model Calibration Statistics. BROS Superfund Site; Logan Township, New Jersey.

Designation	Easting	Northing	Layer	Observed	Computed	Residual
MW-23S	16569.91	18575.91	1	3.49	3.92	-0.43
MW-24S	15974.32	19532.81	1	2.82	2.64	0.18
MW-25S	17078.67	19367.71	1	2.44	3.20	-0.76
MW-26D	16599.07	19059.35	12	1.62	2.09	-0.47
MW-26I	16605.00	19052.07	9	2.29	2.09	0.20
MW-26S	16610.59	19059.05	1	3.54	3.33	0.21
MW-27D	15968.38	19232.23	12	2.17	2.09	0.08
MW-27I	15962.51	19224.41	4	2.17	2.84	-0.67
MW-28S	16071.79	19769.38	1	2.17	2.51	-0.34
MW-29S	16987.71	19238.35	1	2.75	3.28	-0.53
MW-30S	16536.70	19710.23	1	2.48	2.88	-0.40
MW-31S	16754.43	19729.82	1	2.49	2.99	-0.50
MW-33D	14828.16	17357.34	12	0.56	0.82	-0.26
MW-4A	16067.55	18719.81	1	2.69	3.34	-0.65
MW-4D	16056.31	18711.38	12	1.80	1.76	0.04
MW-5B	15599.04	19348.82	12	2.00	2.15	-0.15
MW-6A	15635.60	19955.34	1	2.30	2.17	0.13
MW-6B	15630.98	19940.78	12	1.92	2.14	-0.22
MW-7A	16260.69	20295.36	2	2.39	2.19	0.20
MW-7B	16271.85	20297.81	12	2.12	2.18	-0.06
MW-8A	16938.30	19920.06	2	2.19	2.93	-0.74
MW-8B	16934.39	19915.81	12	1.11	2.55	-1.44
MW-9A	17292.70	19673.14	1	2.79	2.86	-0.07
MW-9B	17280.43	19681.82	12	2.01	2.69	-0.68
NJDEP-1	15616.87	19378.49	11	2.05	2.16	-0.11
P-4	16305.18	18694.37	2	3.08	3.60	-0.52
PZ-5	17038.57	19241.71	3	2.48	3.25	-0.77
PZ-6	16933.96	19143.31	2	3.10	3.34	-0.24
S-11A	16818.97	18901.25	2	3.81	3.53	0.28
S-11B	16836.33	18929.51	11	1.87	2.04	-0.17
S-11C	16828.24	18918.63	12	1.65	2.02	-0.37
S-1C	16155.21	18701.59	3	2.41	3.45	-1.04
S-2A	16972.02	19513.65	1	2.42	3.12	-0.70
S-2B	16964.36	19519.93	9	2.09	2.51	-0.42
S-2C	16957.56	19525.17	12	2.02	2.49	-0.47
S-3A	16266.33	19640.77	1	2.41	2.75	-0.34
S-3B	16264.98	19635.71	9	2.35	2.27	0.08
S-3C	16268.97	19637.26	12	2.22	2.27	-0.05
S-4	15611.90	19356.27	1	2.56	2.69	-0.13
S-5	14942.76	18968.79	9	2.20	2.02	0.18
S-8	16978.86	20206.23	12	2.11	2.58	-0.47
S-9	15302.14	19757.58	9	2.41	2.23	0.18
SG-7	15850.83	19138.91	1	2.88	2.92	-0.04
SG-8	16478.49	18615.66	1	3.86	3.86	0.00
WMW-1B	17252.55	19200.21	1	3.46	3.31	0.14
WMW-2B	16990.73	18956.57	1	3.16	3.50	-0.35
WMW-3B	17443.44	18979.63	1	4.47	3.23	1.24
WMW-4B	17367.52	18849.38	1	3.44	3.31	0.13
WMW-5B	17182.12	18691.57	1	4.70	3.49	1.21
WMW-6B	16935.58	18506.01	1	3.81	3.81	0.00



LEGEND

MW-16B — LOCATION AND DESIGNATION OF MONITORING WELL

NEW JERSEY

QUADRANGLE LOCATION

N

Title:

MONITORING WELL LOCATIONS

Prepared For:

BROS TECHNICAL COMMITTEE

BROS SUPERFUND SITE, NEW JERSEY

ROUX

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/10/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-1
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110708.WOR	Project: 49301J	

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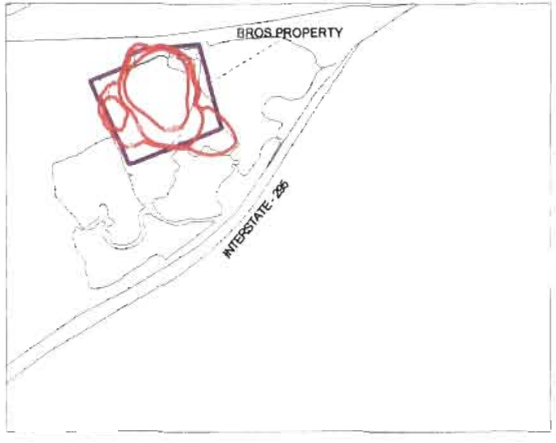
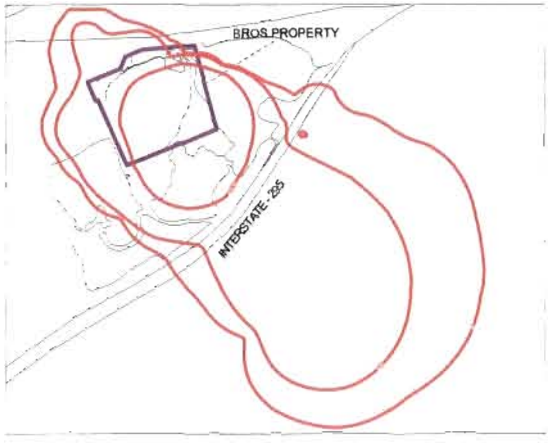


INITIAL CONCENTRATIONS
IN LAYERS 1 THROUGH 5
(UPPER PRM AQUIFER)

INITIAL CONCENTRATIONS
IN LAYERS 9 THROUGH 11
(UPPER MIDDLE PRM AQUIFER)



INITIAL CONCENTRATIONS
IN LAYER 12
(BASE OF UPPER MIDDLE PRM AQUIFER)

1250' 0 1250'

EXPLANATION

100 - ISOCONCENTRATION OF EQUAL TCE CONCENTRATION IN MICROGRAMS PER LITER

PRM - POTOMAC RARITAN MAGOTHY

NOTES:

- NO INITIAL CONCENTRATIONS WERE ENTERED FOR LAYERS 6 THROUGH 8.
- CONTOUR LINES ARE IN LOGARITHMIC SCALE.
- ISOCONCENTRATIONS BASED ON SURFER CONTOURING OF PHASE 2 REMEDIAL INVESTIGATION DATA.

N

TCE

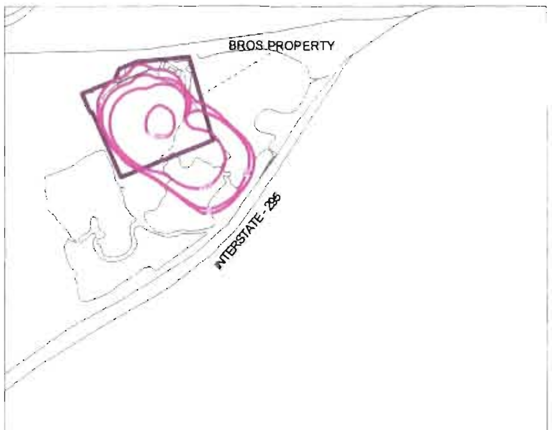
INITIAL BENZENE CONCENTRATIONS USED IN TRANSPORT MODEL

Prepared For:
BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

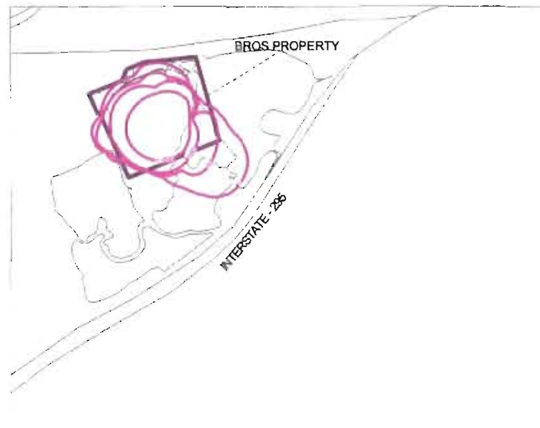
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/10/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-2
Project Mgr: N.R.	Office: N.Y.	
File No: BROS1070T.WOR	Project: 49301J	

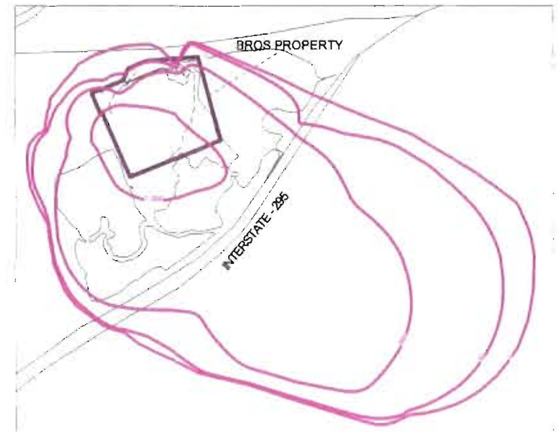
301336



INITIAL CONCENTRATIONS
IN LAYERS 1 THROUGH 5
(UPPER PRM AQUIFER)



INITIAL CONCENTRATIONS
IN LAYERS 9 THROUGH 11
(UPPER MIDDLE PRM AQUIFER)



INITIAL CONCENTRATIONS
IN LAYER 12
(BASE OF UPPER MIDDLE PRM AQUIFER)

1250' 0 1250'

EXPLANATION

100 - ISOCONCENTRATION OF EQUAL BCEE CONCENTRATION IN MICROGRAMS PER LITER

BCEE - BIS(2-CHLOROETHYL)ETHER

PRM - POTOMAC RARITAN MAGOTHY

NOTES:

- NO INITIAL CONCENTRATIONS WERE ENTERED FOR LAYERS 6 THROUGH 8.
- CONTOUR LINES ARE IN LOGARITHMIC SCALE.
- ISOCONCENTRATIONS BASED ON SURFER CONTOURING OF PHASE 2 REMEDIAL INVESTIGATION DATA.

N

INITIAL BCEE CONCENTRATIONS USED IN TRANSPORT MODEL

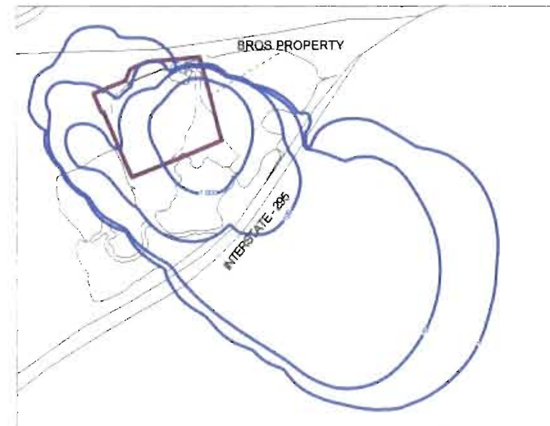
Prepared For:
BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/10/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-3
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110706.WOR	Project: 46001J	

INITIAL CONCENTRATIONS
IN LAYERS 1 THROUGH 5
(UPPER PRM AQUIFER)

INITIAL CONCENTRATIONS
IN LAYERS 9 THROUGH 11
(UPPER MIDDLE PRM AQUIFER)



INITIAL CONCENTRATIONS
IN LAYER 12
(BASE OF UPPER MIDDLE PRM AQUIFER)

1250' 0 1250'

EXPLANATION

—100— - ISOCONCENTRATION OF EQUAL TCE CONCENTRATION IN MICROGRAMS PER LITER

TCE - TRICHLOROETHENE

PRM - POTOMAC RARITAN MAGOTHY

NOTES:
- NO INITIAL CONCENTRATIONS WERE ENTERED FOR LAYERS 6 THROUGH 8.
- CONTOUR LINES ARE IN LOGARITHMIC SCALE.
- ISOCONCENTRATIONS BASED ON SURFER CONTOURING OF PHASE 2 REMEDIAL INVESTIGATION DATA.

N

Title:

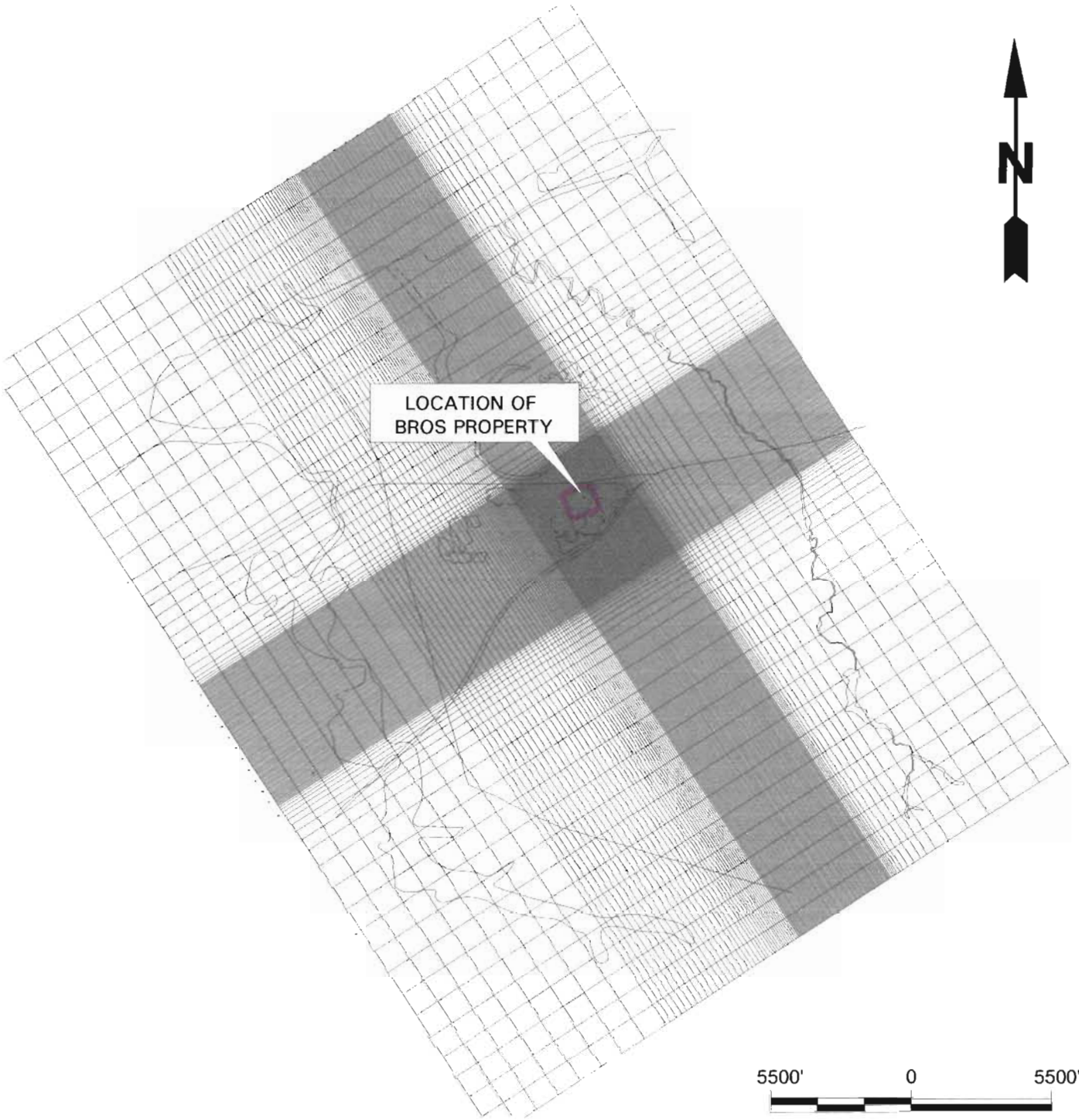
INITIAL TCE CONCENTRATIONS
USED IN TRANSPORT MODEL

Prepared For:

BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

ROUX
ROUX ASSOCIATES INC
Environmental Consulting
& Management

Compiled by: B.S.	Date: 1/10/02	FIGURE
Prepared by: B.S.	Scale: AS SHOWN	A-4
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110705.WOR	Project: 46501J	



Title:

MODFLOW MODEL GRID EXTENT

Prepared For:

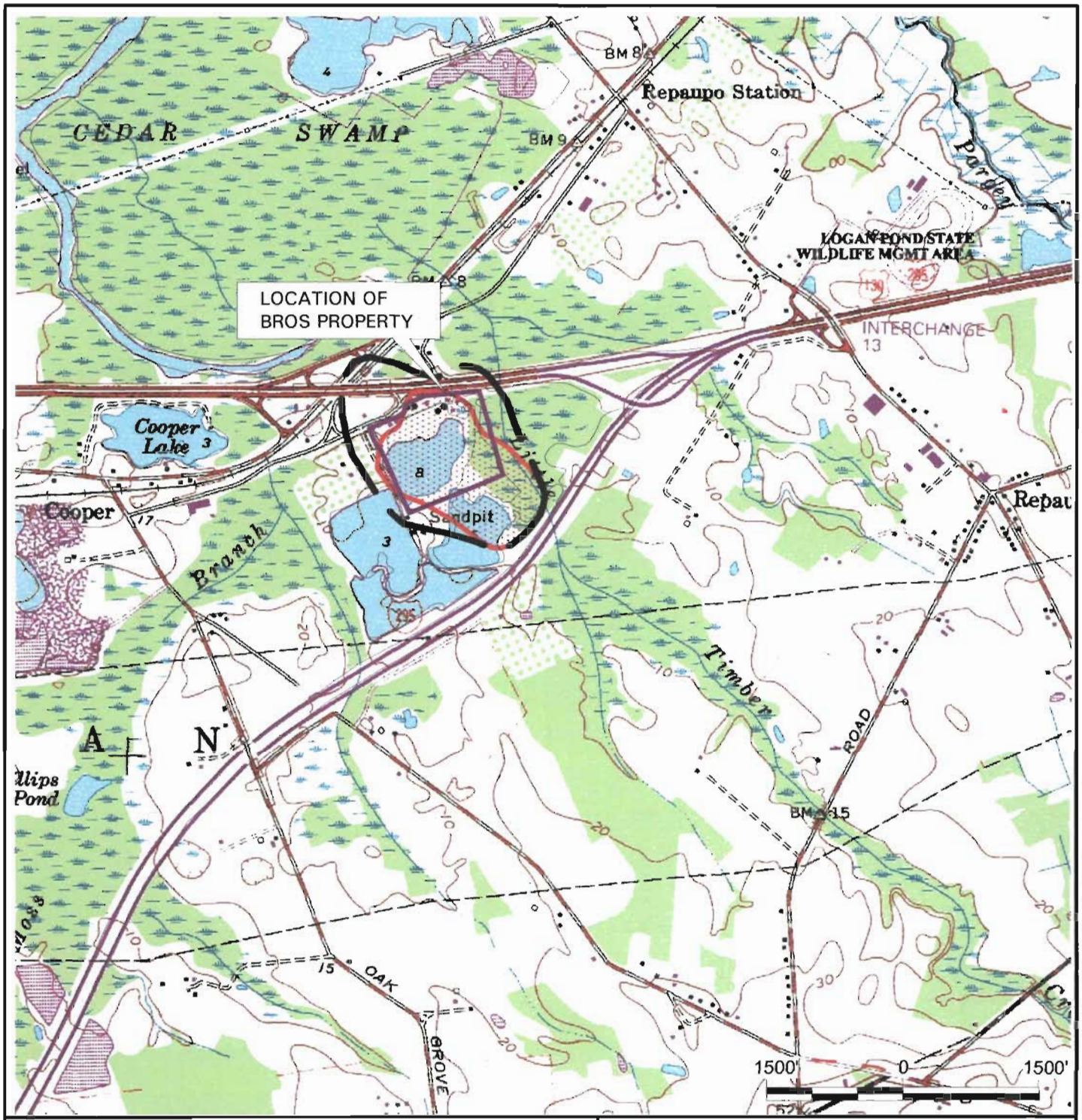
BROS TECHNICAL COMMITTEE

BROS SUPERFUND SITE, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 11/30/01	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-5
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110704.WOR	Project: 49301J	

301339



LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND A PORTION OF THE UPPER PRM AQUIFER

NEW JERSEY

QUADRANGLE LOCATION

N

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR RECENT STRATA AND UPPER PRM AQUIFER

Prepared For:

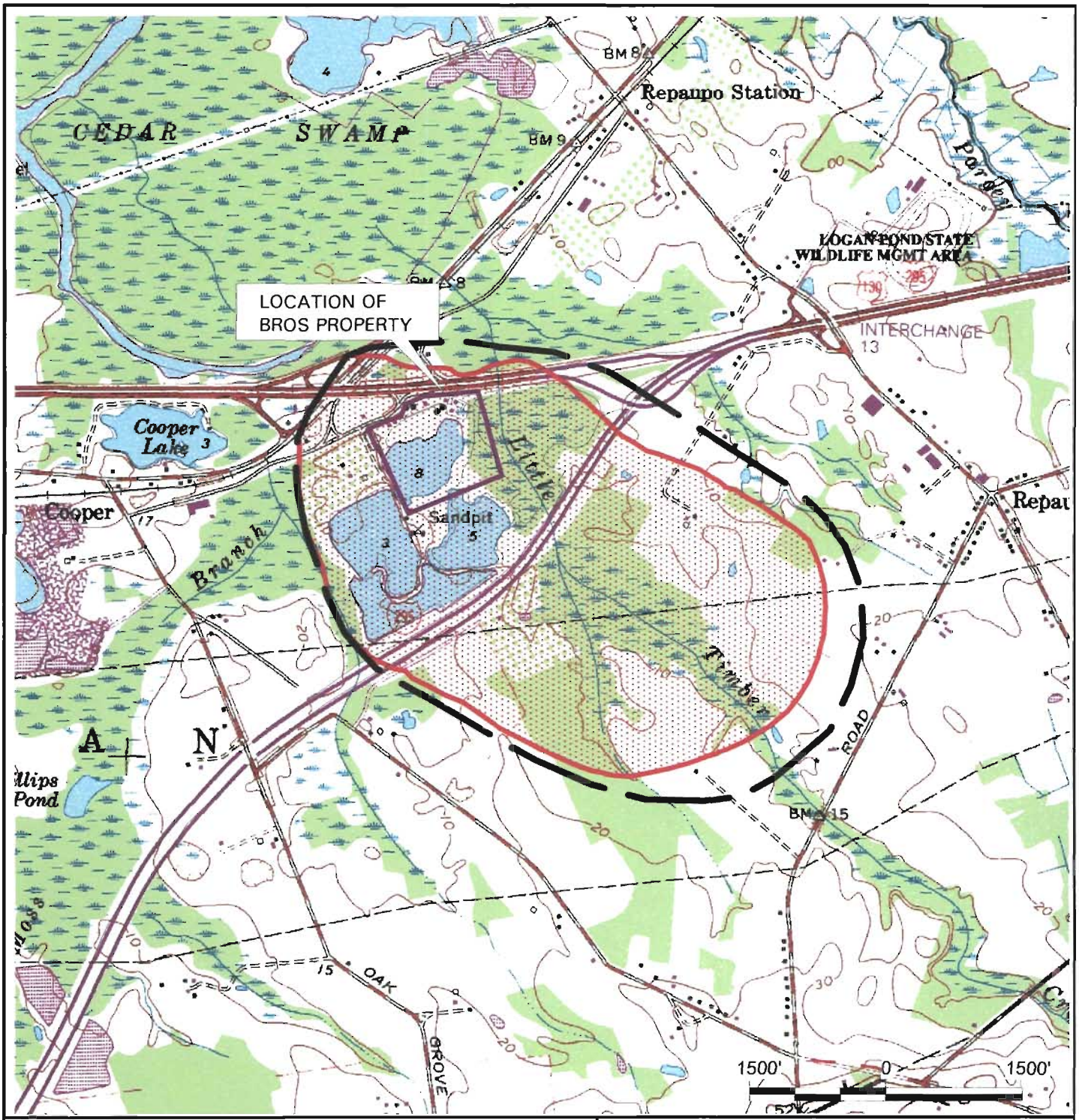
BROS TECHNICAL COMMITTEE

BROS SUPERFUND SITE, NEW JERSEY

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/10/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-6
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110701.WOR	Project: 49301J	

301340



LEGEND

BOUNDARY OF UPDATED WELL RESTRICTION AREA AT THE BASE OF THE UPPER MIDDLE PRM AQUIFER (LOWER 15 FEET)

BOUNDARY OF UPDATED CLASSIFICATION EXCEPTION AREA UPPER MIDDLE PRM AQUIFER

NEW JERSEY

QUADRANGLE LOCATION

Title:

WELL RESTRICTION AREA AND CLASSIFICATION EXCEPTION AREA FOR THE UPPER MIDDLE PRM AQUIFER

Prepared For:

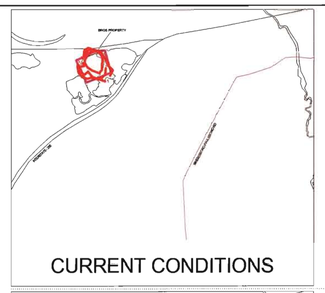
BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

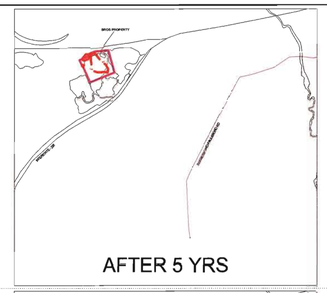
ROUX ASSOCIATES INC
Environmental Consulting & Management

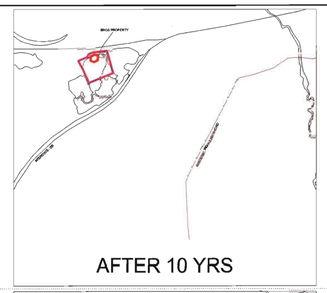
Compiled by: S.S.	Date: 2/12/02	FIGURE
Prepared by: S.S.	Scale: AS SHOWN	A-7
Project Mgr: N.R.	Office: N.Y.	
File No: BP0110702.WOR	Project: 49301J	

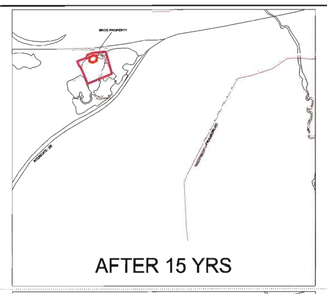
301341

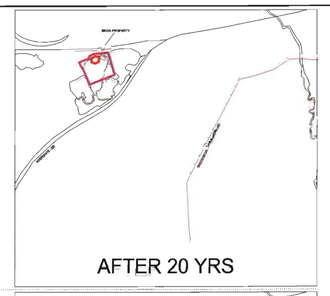
BENZENE TRANSPORT IN RECENT/UPPER PRM AQUIFER



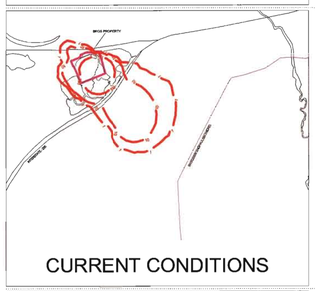


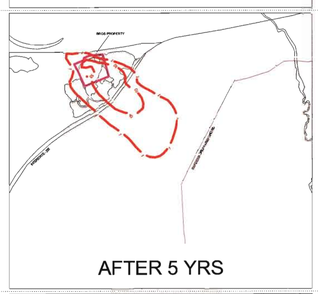


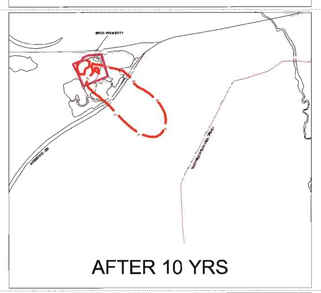


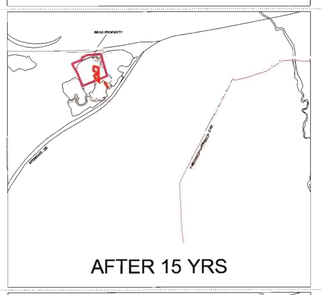


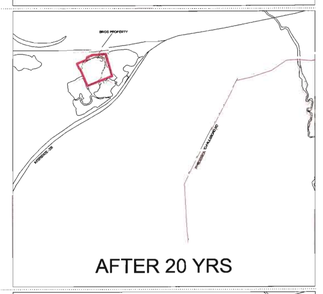
BENZENE TRANSPORT IN UPPER MIDDLE PRM AQUIFER



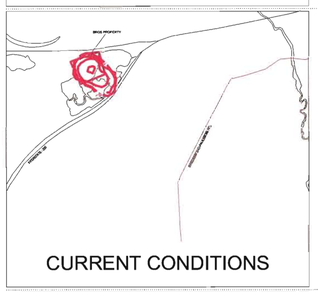


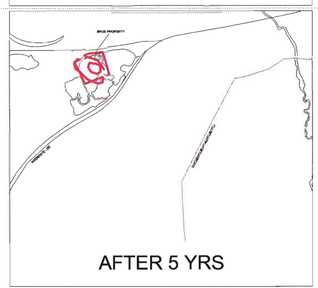


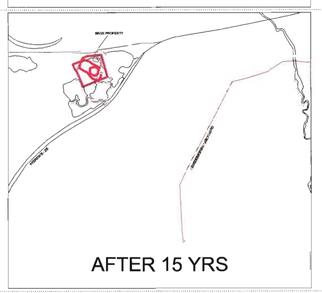


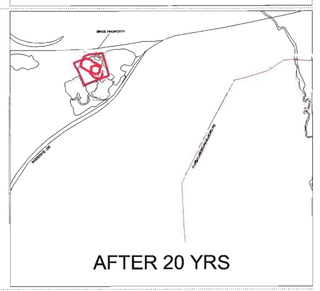


BCEE TRANSPORT IN RECENT/UPPER PRM AQUIFER

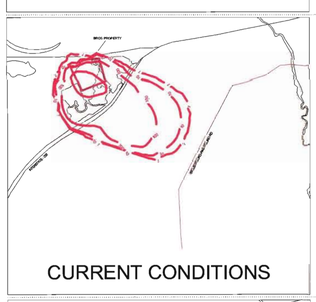


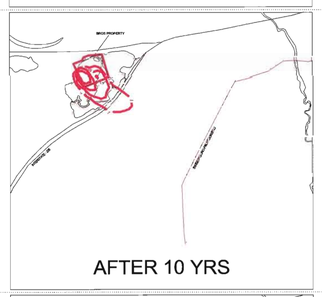




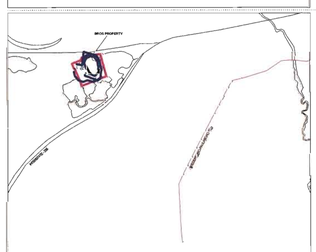


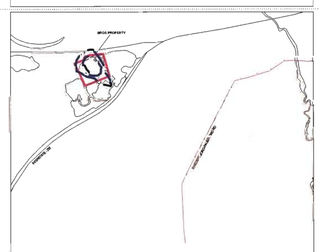
BCEE TRANSPORT IN UPPER MIDDLE PRM AQUIFER

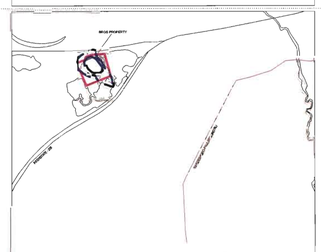




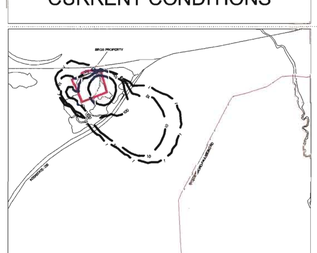
TCE TRANSPORT IN RECENT/UPPER PRM AQUIFER

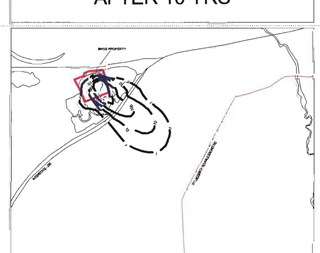






TCE TRANSPORT IN UPPER MIDDLE PRM AQUIFER





EXPLANATION

10 — CONTOUR OF MODELED BENZENE CONCENTRATION IN MICRO GRAMS PER LITER

10 — CONTOUR OF MODELED BCEE CONCENTRATION IN MICRO GRAMS PER LITER

10 — CONTOUR OF MODELED TCE CONCENTRATION IN MICRO GRAMS PER LITER

TCE - TRICHLOROETHENE

BCEE - BIS(2-CHLOROETHYL)ETHER

NOTE: CONTOURS ARE IN LOGARITHMIC SCALE

2,500' 0 2,500'

N

Title:

TRANSPORT MODEL RESULTS FOR BENZENE, BCEE, AND TCE

Prepared For:

BROS TECHNICAL COMMITTEE
BROS SUPERFUND SITE, NEW JERSEY

ROUX ASSOCIATES, INC
Environmental Consulting & Management

Compiled by: S.S.	Date: 1/17/02	PLATE
Prepared by: S.S.	Scale: AS SHOWN	A-1
Project Mgr: N.R.	Office: NY	
File No: BP01\10703	Project: 4830IJ	

301342

APPENDIX B

APPENDIX B

ELECTRONIC MAPS OF PROPOSED CEA BOUNDARIES (COMPUTER DISK)